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16. ABSTRACT The report provides, to states and other participants and users of the 1985 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory, a general understanding of the estimating procedures that will be used by NAPAP and EPA's Office of Air Quality Planning and Standards (OAQPS) to generate 1985 emissions estimates for area source categories. General methodology and assumptions are discussed as well as the original source of algorithms, activity levels, and emission factors. Emission estimates are updated annually by a series of computer programs which multiply each current area source activity level by an emission factor that accounts for emissions removed by any control technology. County emissions estimates are then summed to produce national emissions estimates. For this report area sources are divided into stationary sources, mobile sources, solid waste disposal, miscellaneous area sources, and additional area sources. Additional area sources include categories for which methodologies have been developed to estimate emissions for the 1985 NAPAP Emissions Inventory that are not part of the current National Emission Data System (NEDS) Area Source Categories. NEDS is a nationwide data base of estimated air pollutant emissions from point and area sources developed by OAQPS.

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Final Report

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ABSTRACT

The Environmental Protection Agency Office of Air Quality Planning and Standards (OAQPS) in Research Triangle Park, North Carolina has developed a nationwide data base of estimated air pollutant emissions from point and area sources known as the National Emission Data System (NEDS). Point source emissions estimates for every plant are submitted annually by each State to EPA for review. Area source data files developed from the NEDS system will serve as the basis for the 1985 NAPAP area source emissions inventory. However, to date, NEDS area source data have been developed mainly by OAQPS with data voluntarily submitted by State agencies.

The purpose of this document is to provide States and other participants and users of the 1985 NAPAP Emissions Inventory with a general understanding of the estimation procedures that will be used by NAPAP and OAQPS to generate 1985 emissions estimates for area source categories. General methodology and assumptions are discussed as well as the original source of algorithms, activity levels, and emission factors.

Emission estimates are updated annually by a series of computer programs which multiply each current area source activity level with the appropriate emission factor which accounts for emissions removed by any control technology. County emissions estimates are then summed to produce national emissions estimates.

For the purpose of this document, area sources are divided into stationary sources, mobile sources, solid waste disposal, miscellaneous area sources, and additional area sources. Additional area sources includes categories for which methodologies have been developed to estimate emissions for the 1985 NAPAP Emissions Inventory that are not part of the current NEDS Area Source Categories.

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SECTION 1

EXECUTIVE SUMMARY

The Environmental Protection Agency Office of Air Quality Planning and Standards (OAQPS) in Research Triangle Park, NC has developed a nationwide data base of estimated air pollutant emissions from point and area sources known as the National Emission Data System (NEDS). Point source emissions estimates for every plant are submitted annually by each State to EPA for review. Area source data files developed from the NEDS system will serve as the basis for the 1985 NAPAP area source inventory. However, to date, NEDS area source data have been developed mainly by OAQPS with data voluntarily submitted by State agencies.

The purpose of this document is to provide States and other participants and users of the 1985 NAPAP inventory with a general understanding of the estimation procedures that will be used by NAPAP and OAQPS to generate 1985 emissions estimates for area source categories. General methodology and assumptions are discussed as well as the original source of algorithms, activity levels, and emission factors necessary to calculate emissions for each area source in NEDS.

Activity levels are derived primarily from related information published by other Federal agencies, supplemented by special data developed by EPA for the purpose of developing NEDS area source inventories. Published data such as fuel use by State, motor vehicle miles of travel by state and county, and forest fire acres burned by state are used with related data such as employment, population, and miscellaneous geographic or economic data to derive annual county estimates of the activity levels for each of the NEDS area source categories. The activity levels derived are adjusted to account for point source activity (such as fuel use by point sources) so that the area source data reflect only the activity levels (and resulting calculated emissions) that are not accounted for by point sources.

Area source emissions estimates for five pollutants (particulates, SOx, NOx, VOC and CO) are calculated for each area source category utilizing appropriate emission factors from NEDS area source emission factor file. For most categories, emission factors were originally obtained from Environmental

Protection Agency Compilation of Air Pollutant Emission Factors (AP-42). For many categories, the same emission factors are used for all counties; however, for some source categories, state or county specific emission factors account for local variables that affect emissions. The more specific factors are used in NEDS calculations for all highway motor vehicle categories, fugitive dust categories, and for selected other categories in a few counties where data are available to develop more applicable emission factors than the national emission factors. Provision is also made to override computer-calculated emissions with hand-calculated emissions that may be more accurate than any simple emission factor calculation.

Emission estimates are updated annually by a series of computer programs which multiply each current area source activity level with the appropriate emission factor which accounts for emissions removed by any control technology. County emission estimates are then summed to produce national emissions estimates.

Area sources are divided into five major groups, namely, Stationary Sources, Mobile Sources, Solid Waste Disposal, Miscellaneous Area Sources, and Additional Area Sources. Additional Area Sources includes categories for which methodologies have been developed to estimate emissions for the 1985 NAPAP inventory that are not part of the current NEDS Area Source Categories.

STATIONARY SOURCES

Stationary sources are divided into three major categories: Residential Fuel, Commercial and Institutional Fuel, and Industrial Fuel. Collectively, these categories account for all stationary fuel combustion activity not usually reported as point sources. Each category is further subdivided into fuel types. For each of the above categories, consumption data are multiplied by emission factors to obtain emissions estimates.

The residential fuel category estimates emissions for residential activities which utilize fuel for water heating, space heating, and cooking. Emissions contributed by residential fuel consumption are determined for six fuel types. County activity levels, measured by fuel quantity consumed in weight or volume units, are calculated for each of the listed fuel types using county-specific data and then normalized with published state data.

Area source emissions from fuel use by commercial and institutional sources consists of emissions from all fuel burned in stationary sources that are not included under residential sources, industrial sources, power plants, or commercial point sources. Important commercial/institutional area sources are hospitals, hotels, laundries, schools, and universities.

Consumption data for each fuel type is obtained in the following steps: (1) estimating total county fuel consumed by the five identified commercial subcategories, (2) distributing total fuel consumption by the subcategories to each fuel type, (3) determining state total commercial area source fuel consumption, (4) normalizing estimates against published state consumption, and (5) determining and allocating county consumption by "other" commercial categories.

Emissions generated by the industrial sector which are not accounted by point source categories are calculated for four fuel types: bituminous coal, distillate oil, residual oil, and natural gas. County fuel consumption is estimated by multiplying county employment figures for SIC categories 20 through 39 by a fuel intensity factor. Results are then normalized with published state values.

MOBILE SOURCES

Mobile sources which contribute to area source emissions are divided into Highway Vehicles, Off-Highway Vehicles, Railroad Locomotives, Aircraft, and Marine Vessels.

Highway vehicles disaggregates motor vehicles into four categories on the basis of vehicle type and gross vehicle weight for the purpose of calculating consumption. The categories include light duty gasoline vehicles, light duty gasoline trucks, heavy duty diesel vehicles and heavy duty gasoline vehicles. NEDS utilizes vehicle type registration data and published average miles travelled by each vehicle type to allocate consumption to the county level. Fuel consumption, average fuel efficiencies and road type mileage in each county are used to determine vehicle miles travelled (VMT) for three road classes: limited access roads, rural roads and urban roads. Emission factors in grams per mile obtained from the execution of a computer model are applied so as to determine emissions for vehicle type and speed class.

Emissions from off-highway vehicles are generated by activities of gasoline and diesel vehicles which do not utilize road systems. Vehicles contributing to off-highway emissions are divided into six general categories: farm equipment, construction equipment, industrial equipment, motorcycles, lawn and garden equipment, and snowmobiles. Consumption is estimated separately for each category by either apportioning national fuel consumption to counties on the basis of employment, population, etc., or calculating county or state totals by applying national fuel consumption rates to average usage figures and equipment populations. Emission factors are weighted for each category using equipment populations. Off-highway motorcycle emissions are computed using a model which simulates uncontrolled emissions.

The activity level for railroad locomotive use of distillate oil is calculated by allocating published state consumption data to the county level based on county population statistics. Consumption, reported in 103 gallons, is used with emission factors to determine emissions.

Activity level calculations for aircraft (civil, military, and commercial) utilize airport operations data and plane type populations to estimate the number of landing take-off cycles (LTOs) in each group. Emission factors are defined as emissions per LTO.

Marine vessel consumption of distillate oil, residual oil, and gasoline is determined by adjusting published State consumption data. County allocation of distillate and residual oil consumption by vessels utilizes home port location for registered boats and port tonnage handled for the remaining boat population. Gasoline vessel consumption computations utilize inboard and outboard boat registration and published average consumption data to determine consumption. County allocation is based on inland water area, coastline and the number of months suitable for recreational boating. Emission factors are applied to consumption data to obtain emissions estimates.

SOLID WASTE DISPOSAL

The area source category for solid waste disposal includes on-site refuse disposal activities by residential, commercial/institutional and industrial sectors. Solid waste generation in hundreds of tons is used as a measure of activity level for burning and on-site incineration. This is multiplied by specific emission factors to obtain emissions estimates.

MISCELLANEOUS AREA SOURCES

NEDS area sources which are not defined by the first three categories are compiled in the miscellaneous area sources category. Methodologies have been developed for area categories even though total emissions from each source are relatively small compared to the major categories, because emissions at a particular time may be significant. Methodologies are presented for the following: Gasoline Marketed, Organic Solvent Consumption, Unpaved Road Travel, Unpaved Air Strip Use, Land Tilling, Forest Wildfires, Managed Burning, Agricultural Burning, and Structural Fires.

In brief, activity levels, estimated using category-specific data, are multiplied by emission factors to obtain emissions estimates. Activity levels for Gasoline Marketed are determined using county retail service station sales data. Activity levels for Organic Solvent Consumption are determined by allocating national estimates of organic solvent consumption by end use category to counties according to manufacturing employment data or population. The Unpaved Road Travel category utilizes vehicle miles travelled (VMT) andrural population for the basis of fuel consumption allocation. Unpaved Airstrip Use is measured by landing-takeoff (LTO) cycles. Number of acres burned and fuel loading factors are used to measure activity levels for Forest Wildfires, Managed Burning, and Agricultural Burning. The Structural Fires category utilizes the number of building fires to allocate activity level to the county level.

ADDITIONAL AREA SOURCES

The 1985 NAPAP inventory will provide detailed county level VOC emissions estimates for additional area sources which previously have not been included in the NEDS area source categories. The categories were included to account for differences between published total emissions and NEDS point source data. Alliance methodologies developed for the 1985 NAPAP inventory are presented for the following area sources: Publicly Owned Treatment Works (POTWs); Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs); Fugitive Emissions From Synthetic Organic Chemical Manufacturing; Bulk Terminals and Bulk Plants; Fugitive Emissions from Petroleum Refining Operations; Process Emissions from Bakeries, Pharmaceutical, and Synthetic-Fiber Manufacturing; Crude Oil and Natural Gas Production Fields; and Cutback Asphalt Paving Operations. For most categories, national VOC emissions estimates are allocated to the county level using category-specific data such as industrial flow and production figures. Activity levels, emission factors, and control efficiencies are used to determine emissions for the remaining sources.

SECTION 2

INTRODUCTION

The Environmental Protection Agency Office of Air Quality Planning and Standards (OAQPS) in Research Triangle Park, NC has developed a nationwide data base of estimated air pollutant emissions from point and area sources known as the National Emission Data System (NEDS). Point source emissions estimates for every plant are submitted annually by each State to EPA for review. Area source data files developed from the NEDS system will serve as the basis for the 1985 NAPAP area source inventory. However, to date, NEDS area source data have been developed mainly by OAQPS with data voluntarily submitted by State agencies.

The purpose of this document is to provide States and other participants and users of the 1985 NAPAP inventory with a general understanding of the estimation procedures that will be used by NAPAP and OAQPS to generate 1985 emissions estimates for area source categories. General methodology and assumptions are discussed as well as the original source of algorithms, activity levels, and emission factors necessary to calculate emissions for each area source in NEDS.

The document presents methodologies for all identified sources not defined as point sources in a specific geographic region. Area sources include all mobile sources, and stationary sources too small, difficult or numerous to classify as point sources. Area sources are divided into five major groups, namely, STATIONARY FUEL COMBUSTION, MOBILE SOURCES, SOLID WASTE DISPOSAL, MISCELLANEOUS AREA SOURCES, and ADDITIONAL AREA SOURCES. ADDITIONAL AREA SOURCES includes categories for which methodologies have been developed to estimate emissions for the 1985 NAPAP inventory that are not part of the current NEDS Area Source Categories. Activity level and emission factor methodologies used to produce emissions estimates are presented for each area source within the above groups.

Activity levels are derived primarily from related information published by other Federal agencies, supplemented by special data developed by EPA for the purpose of developing NEDS area source inventories. Published data such as fuel use by State, motor vehicle miles of travel by state and county, and forest fire acres burned by state are used with related data such as employment, population, and miscellaneous geographic or economic data to derive annual county estimates of the activity levels for each of the NEDS area source categories. The activity levels derived are adjusted to account for point source activity (such as fuel use by point sources) so that the area source data reflect only the activity levels (and resulting calculated emissions) that are not accounted for by point sources.

Area source emissions estimates for five pollutants (particulates, SO_x, NO_x, VOC, and CO) are calculated for each area source category utilizing appropriate emission factors which are contained in the NEDS area source emission factor file. For many categories, the same emission factors are used for all counties; however, for some source categories, state or county specific emission factors account for local variables that affect emissions. The more specific emission factors are used in NEDS calculations for all highway motor vehicle categories, fugitive dust categories, and for selected other categories in a few counties where data are available to develop more applicable emission factors than the national emission factors. Provision is also made to override computer-calculated emissions with hand-calculated emissions that may be more accurate than any simple emission factor calculation.

Emissions estimates are updated annually by a series of computer programs which multiply each current area source activity level with the appropriate emission factor which accounts for emissions removed by any control technology. County emissions estimates are then summed to produce national emissions estimates.

SECTION 3

STATIONARY SOURCES

Stationary sources which contribute to area source emissions have been divided into three major categories: Residential Fuel, Commercial and Institutional Fuel, and Industrial Fuel. Collectively, these categories account for all stationary fuel combustion activity not usually reported as point sources. Each category is further subdivided into the following fuel types: anthracite coal, bituminous coal, distillate oil, residual oil, natural gas, wood, industrial coke and process gas. Methodologies for activity level estimation and emission factor derivation are discussed for each category fuel type.

RESIDENTIAL FUEL

The residential fuel category estimates emissions for residential activities which utilize fuel for water heating, space heating, and cooking. Emissions contributed by residential fuel consumption are broken down into 5 categories according to the type of fuel. Fuel types included are anthracite coal, bituminous coal, distillate oil, natural gas, and wood. No methodology has been developed for the residential residual oil category. Emissions from this category are considered insignificant compared to the emissions from other fuels. For each of the listed fuel types, activity levels measured by fuel quantity consumed in weight or volume units are multiplied by emission factors to obtain emissions estimates. Methodologies for activity levels and emission factors are presented below.

Activity Levels

In the following methodologies for the calculations of activity levels, consumption is determined for each type of fuel using two general steps.

- County consumption is calculated using an algorithm which is based on significant variables for which county-specific data are available (i.e., degree days, number of rooms per dwelling, number of dwellings, etc.).
- Resulting county consumption estimates are normalized to reflect published state consumption data by the following equation:

$$\begin{array}{c}\text{Normalized}\\ \text{County}\\ \text{Consumption}\end{array} = \begin{array}{c}\text{Estimated}\\ \text{County}\\ \text{Consumption}\end{array} \times \frac{\text{Published State Consumption}}{\text{Estimated State Consumption}}$$

Anthracite and Bituminous Coal

The basic methodology for allocating residential consumption of anthracite and bituminous coal to individual counties involves the use of an algorithm which relates coal consumption to number of dwelling units and heating degree days. Adjustments are made to housing data to account for secular trends in the number of coal-heated dwelling units, and to disaggregate the total coal consumption into anthracite and bituminous components. Then the results are normalized as necessary in the following steps.

Total county residential consumption of coal (anthracite and bituminous) is calculated based on an algorithm derived by Walden.[1] Variables found to be significant by regression analyses were the number of occupied dwelling units in the county using coal for space heating and the annual heating degree days for the county. Dwelling unit data from the last census are updated using a regional growth factor which reflects the number of dwellings converted to or from coal space heating. Total residential consumption is then distributed to the coal type on the basis of its share of the total state coal market.

Published state consumption is determined as the difference between state shipments of each coal type for retail use and state commercial point source consumption. County consumption estimates for each coal type are summed over the state and normalized to reflect published state consumption by one of three methods.

(1) If both state residential consumption estimates exceed their respective published state consumption figures, county consumption estimates for both fuels are normalized using a coal type-specific factor of published state coal consumption to estimated state residential coal consumption.

(2) If both state residential consumption estimates are less than state retail area consumption for both coal types, no adjustments are made.

(3) If state estimated residential consumption exceeds published state consumption for one coal type but does not exceed the published state consumption for the other type, the lesser value of the differences between the computed and published values is distributed among counties of the coal type for which the estimated exceeded the published consumption.

Number of dwelling units is obtained for each census year from the Bureau of Census Census of Housing.[2] Dwelling update factors for regional growth of coal heated housing are found in Bureau of Census Annual Housing Survey.[3] Number of annual heating degree days per county are taken from NOAA climatological data.[4] Percentage of coal types in the residential coal market was obtained by personal communication with coal officials at the Department of Energy.[5] Retail shipments of each type of coal to commercial point sources and each state are found in Energy Information Administration Coal Distribution January-December.[6] For this reference, anthracite production is represented by district 24; the remaining districts produce bituminous coal.

Distillate Oil

Consumption of distillate oil by residential sources is determined by allocating state consumption to the county level using housing data. Total county residential consumption is calculated as the sum of distillate oil used for space heating and non-space heating for the most recent census year and then normalized with total State consumption.

Walden[7] incorporated EPA factors with variables and performed regression analyses to arrive at an algorithm which determines county consumption of fuel for space heating and water heating using the annual heating degree days and the median number of rooms of occupied dwelling units for each county.

Distillate oil used for non-space heating purposes is estimated by assuming that each housing unit utilizes 250 gallons of oil per year for hot water heating purposes.[8]

The number of annual heating degree days in each county is found in NOAA climatological data.[4] The median number of rooms per dwelling unit in each county is obtained from Bureau of Census _County and City Data Book_.[9] Dwelling statistics are compiled for each census year in Bureau of Census _Census of Housing_.[2] Total State consumption data is available in DOE _Petroleum Marketing Monthly_.[10]

Natural Gas

In the NEDS inventory, residential natural gas consumption is defined as the sum of natural gas consumption and LPG consumption for the purposes of cooking, water heating and space heating. In general, the methodology is designed to produce county consumption estimates for each use by fuel type, normalize the county estimates with published data, and then combine the final county estimates for natural gas and LPG. More detailed description of the methodologies used for the estimation of natural gas and LPG consumption are discussed separately below.

(1) _Natural Gas_: The methodology for determining residential natural gas consumption consists of performing a series of calculations to update census data so that it can be input into an algorithm which computes consumption. The final result is then normalized by comparing it to published state data.

Walden[1] utilized regression analyses to develop an algorithm which calculated natural gas consumption based on annual heating degree days, the number of occupied dwelling units using gas for cooking or water heating fuel, and the median number of rooms per dwelling.

The number of occupied dwelling units in the county using gas for space heating in the current year is determined using number of of dwellings with gas heat in the census year updated to include the increase in the number of gas heating dwellings since the census year. Increase in the number of gas heated dwellings per county is estimated by summing (1) the number of additional gas heated dwellings in the state due to new housing starts distributed to the county level by population and (2) the number of conversions to gas space heating in the state since the census year distributed to the county level by the proportion of dwelling units using gas heat in the census year.

An estimate of the number of occupied dwelling units in the county using gas for all purposes in the current year is computed by dividing the updated number of gas heated dwellings by the percentage of residential gas customers known to have gas heat from gas utility statistics.

The number of dwellings using gas for all purposes is input with heating degree days and median number of rooms per dwelling into an algorithm which yields county estimates of natural gas consumption. County estimates are then totalled and compared with published state residential consumption which are defined as the difference between the total retail shipments and natural gas used by commercial point sources. Final county consumption of natural gas is then combined with LPG data before applying emission factors.

Annual heating degree days are taken from NOAA climatological data.[4] The number of dwellings using natural gas for space heating and water heating per county are available in the Census of Housing.[2] Median number of rooms per dwelling is obtained from the County and City Data Book.[9] Percentage of residential customers using gas for space heating, and residential gas heat conversions and heating unit additions data are found in Gas Househeating Survey.[11] Current county population is found in Current Population Reports.[12] Average regional natural gas consumption is obtained from Gas Facts[13], and (published) residential consumption data is taken from Natural Gas Annual.[14]

(2) LPG: County residential consumption of LPG was determined by Walden[1] to be approximated by an algorithm using county annual heating degree days, the number of occupied dwelling units in the county using LPG for space heating, water heating and cooking fuel in the county, and the average regional consumption by water heaters and cooking ranges.

County estimates are then compared to published data on retail sales of LPG to the commercial and residential sectors. If the sum of the county LPG consumption estimates exceeds the published total, the county figures are normalized against the published total. Otherwise, the county estimates are left unchanged and the remainder of published state retail consumption is used as the commercial consumption for the state. Final county consumption of LPG is combined with natural gas consumption before applying emission factors.

Annual heating degree days are taken from NOAA climatological data.[4] The number of occupied dwelling units in the county using LPG for space heating and water heating are available from the Census of Housing.[2] Average regional consumption data are obtained from Gas Facts.[13] Retail sales information is found in API Sales of Natural Gas Liquids and Liquefied Refinery Gases.[15]

Wood

Residential wood consumption is estimated by updating published state figures with annual regional data and then allocating to the county level based on the number of dwelling units reported heating with wood in each county.

The original state estimates presented in DOE Estimates of U.S. Wood Energy Consumption[16] are updated annually using regional data from Bureau of Census Annual Housing Survey.[3] Wood heated dwellings per county are available in Bureau of Census Census of Housing.[2]

Emission Factors

In the following section, sources of emissions factors used for emission estimation are presented for each fuel for which consumption methodologies are available.

Anthracite Coal

Emission factors for anthracite use in hand-fired boilers are taken directly from AP-42.[17] For the purposes of this calculation, ash content value and sulfur content value are assumed to be 11 percent and 0.7 percent, respectively.[18]

Bituminous Coal

The emission factors for hand-fired units are obtained from AP-42.[17] For SO_2, the average sulfur content is the weighted average of the sulfur content of each production district from Coal Production.[19] District averages are then weighted according to shipment data for each 'district to destination' ("Other Consumers") contained in DOE Coal Distribution.[6]

Distillate Oil

Emission factors are taken directly from AP-42.[17] For VOC, the non-methane VOC emission factor is used. For the SO_2 factor, average sulfur content values for No. 1 and No. 2 fuel oils reported in Heating Oils[20] are weighted by corresponding deliveries to residential users found in DOE Petroleum Marketing Monthly.[10]

Natural Gas

Emission factors applied to the sum of natural gas and LPG consumption are obtained from AP-42.[17] For VOC, the non-methane VOC factor is used.

Wood

Emission factors for woodstoves and fireplaces obtained from AP-42[17] are weighted based on the proportions of wood burned in woodstoves and in fireplaces.

Weighting is accomplished by performing a series of calculations on computed wood consumption estimates which includes: (1) estimating the number of stoves based on shipments and imports from Estimates of U.S. Wood Energy Consumption,[16] (2) calculating an obsolescence rate to determine the total stove inventory in current use, and (3) determining the stove population in primary and secondary use based on the number of dwellings in the county as found in the Annual Housing Survey.[3] Stove efficiency is also taken into account.

COMMERCIAL AND INSTITUTIONAL FUEL

Area source emissions from fuel use by commercial and institutional sources consists of emissions from all fuel burned in stationary sources that are not included under residential sources, industrial sources, power plants, or commercial point sources. Important commercial/institutional area sources are hospitals, hotels, laundries, schools, and universities. Fuel types included in the discussion of activity levels and emission factors are anthracite coal, bituminous coal, distillate oil, residual oil, natural gas, and wood.

Activity Levels

Activity levels are estimated for anthracite coal, bituminous coal, distillate oil, residual oil, and natural gas together using the methodology which is described in the Anthracite Coal section. Fuel-specific references are cited in the appropriate fuel section. No methodology has been developed for the commercial/institutional wood category. Emissions from this source are considered neglible compared to those from other sources.

Anthracite Coal

County commercial/institutional area source activity levels of anthracite coal, bituminous coal, distillate oil, residual oil, natural gas and LPG are calculated for five major subcategories, namely, hospitals, hotels, commercial laundries, schools, and universities. The methodology developed by Walden[1] obtains consumption data for each fuel type in the following steps: (1) estimating total county fuel consumed by the five identified commercial subcategories, (2) distributing total fuel consumption by the subcategories to each fuel type, (3) determining state total commercial area source fuel consumption, (4) normalizing estimates against published state consumption, and (5) determining and allocating county consumption by "other" commercial categories. Please note that after step 2 in this methodology, the term 'consumption' refers to consumption by a specific fuel type.

(1) Total fuel consumption is calculated in therms for each of five major commercial/institutional subcategories. For reference purposes, one therm equals 10^5 BTU. Regression analyses were used to determine significant variables in each subcategory. Each subcategory is discussed separately below.

Hospitals: Walden[1] developed an algorithm which computes county consumption based on the number of hospital beds, annual heating degree days, and county hospital employment. The number of hospital beds and hospital employment in each county are obtained from American Hospital Association: Guide to the Health Care Field.[21] Annual degree days are found in NOAA climatological data.[4]

Hotels: The algorithm developed by Walden[1] calculates county consumption based on annual heating degree days and the number of hotel rooms in each county. Degree day data are found in NOAA climatological data.[4] The number of hotel rooms per county is calculated using county hotel employment from County Business Patterns[22] and the state hotel employee per room ratio from the Bureau of Census Census of Service Industries.[23]

Laundries: According to research done by Walden,[1] county fuel consumption is related only to the county employment in commercial laundries. Employment data for commercial laundries are found in Bureau of Census County Business Patterns.[22]

Schools: County fuel consumption by schools is calculated using annual heating degree days, and county employment in public and private schools.[1] County employment in public school is estimated by allocating state public school employment to each county based on the population of persons ages 3 to 34 enrolled in regular public elementary and secondary schools.

Annual heating degree days are found in NOAA climatological data.[4] County employment in private schools is obtained from Bureau of Census County Business Patterns.[22] County public school employment is estimated using State information from Statistics of Public Elementary and Secondary Schools[24] and enrollment data from Bureau of Census Census of Population.[25]

Universities: The algorithm used to compute county fuel consumption requires annual heating degree days and university employment in the county.[1] For the purpose of this calculation, county university employment is determined by multiplying the sum of public and private institution enrollment by a national employment to enrollee ratio.

Heating degree days are available in NOAA climatological data.[4] University enrollment statistics are obtained from the *Education Directory: Colleges and Universities*.[26] The national ratio of employee to enrollee is found in *Number and Characteristics of Employees in Institutions of Higher Learning*.[27]

(2) Fuel consumption estimates for the five commercial subcategories are summed over the state and distributed among the fuel types according to the proportion of occupied residential dwelling units in the state using those respective fuels for space heating. Information is obtained from the Bureau of Census *Census of Housing*.[2]

Subcategory consumption data are then converted from therms to the standard NEDS units for each fuel type (cubic feet for natural gas, gallons for LPG, tons for coal, etc). Anthracite coal consumption is converted from therms to tens of tons using 4.07×10^{-4} as the fuel equivalence factor.

(3) State commercial/institutional area source consumption for each fuel type is determined using the following equation:

$$\begin{matrix}\text{State}\\ \text{Area Source}\\ \text{Consumption}\end{matrix} = \begin{matrix}\text{Published}\\ \text{State}\\ \text{Consumption}\end{matrix} - \left(\begin{matrix}\text{State}\\ \text{Point Source}\\ \text{Consumption}\end{matrix} + \begin{matrix}\text{State}\\ \text{Residential}\\ \text{Consumption}\end{matrix}\right)$$

For anthracite coal, published state consumption is measured by commercial shipments of anthracite to each state.

(4) State consumption of each fuel type by all commercial area sources other than the five subcategories and normalization of estimated state consumption are computed by the following method. The five subcategory consumption totals (for each fuel type) are compared with the total state area source consumption calculated in step 3. This results in one of two conditions.

- If the total of the subcategory estimates exceeds the total commercial area source consumption, the area source consumption by "other" commercial categories is assumed to be zero. Normalized county commercial consumption is obtained using the following equation:

$$\text{County Commercial Consumption} = \text{Estimated County Consumption by Special Subcategories} \times \frac{\text{State Area Source Consumption}}{\text{State Commercial Consumption by Special Subcategories}}$$

- If the total of the subcategory estimates is less than the total commercial area source consumption, the difference becomes the area source consumption by "other" commercial categories. The total area source consumption is assumed not to require correction (i.e., the normalization factor equals 1).

(5) The area source consumption by "other" commercial categories from step 4 is apportioned to counties by means of adjusted commercial employment. This is defined as the combined employment for subcategories (hospitals, hotels, etc.) subtracted from total county commercial employment found in *County Business Patterns*.[22]

Commercial shipments of anthracite are found in DOE *Coal Distribution*.[6] Consumption of anthracite coal by commercial/institutional point sources is obtained from NEDS point source data.[28] Residential area source consumption is calculated in RESIDENTIAL FUEL Anthracite Coal.

Bituminous Coal

The entire methodology for the estimation of consumption for each fuel is described in Anthracite Coal. By this methodology, total fuel consumption in therms is calculated for five commercial and institutional categories and then allocated to each fuel type. Bituminous coal consumption is then converted from therms to tens of tons using 3.85×10^{-4} as the fuel equivalence factor.

State commercial area source consumption of bituminous coal is the difference between the state shipments to retail dealers and the sum of state commercial/institutional point source consumption and the normalized state residential consumption. State consumption of bituminous coal by sources other than the five subcategories and normalization are computed by the same methods as in steps 4 and 5 in Anthracite Coal.

Information concerning the state shipments of bituminous coal to retail dealers is found in DOE Coal Distribution.[6] State commercial point source consumption is obtained from NEDS point source data.[28] Normalized residential consumption is calculated in the previous section entitled RESIDENTIAL FUEL Bituminous Coal.

Distillate Oil

The entire methodology for the estimation of consumption for each fuel is described in Anthracite Coal. By this methodology, total fuel consumption in therms is calculated for five commercial and institutional categories and then allocated to each fuel type. Distillate oil consumption is then converted from therms to 10^3 gallons using 7.14×10^{-5} as the fuel equivalence factor.

State commercial area source consumption by distillate oil is the difference between the sum of state distillate oil sales to the military and sales for heating purposes, and the sum of state commercial/institutional point source consumption and the normalized state residential consumption. State consumption of distillate oil by sources other than the five categories and normalization are computed by the same methods as in steps 4 and 5 in Anthracite Coal.

Information concerning the state shipments of distillate oil to the military and for commercial purposes are found in DOE Petroleum Marketing Monthly.[10] State commercial point source consumption is obtained from NEDS point source data.[28] Normalized residential consumption is calculated from the previous section entitled RESIDENTIAL FUEL Distillate Oil.

Residual Oil

The entire methodology for the estimation of consumption for each fuel is described in Anthracite Coal. By this methodology, total fuel consumption in therms is calculated for five commercial and institutional categories and then allocated to each fuel type. Residual oil consumption is then converted from therms to 10^3 gallons using 6.67×10^{-5} as the fuel equivalence factor.

State commercial area source consumption by residual oil is the difference between the sum of state residual oil sales to the military and sales for heating purposes, and the state commercial/institutional point source consumption. No residual oil is utilized for residential purposes. State consumption of residual oil by sources other than the five subcategories and normalization are computed by the same methods as in steps 4 and 5 in Anthracite Coal.

Information concerning the state shipments of residual oil to the military and for commercial purposes are found in DOE Petroleum Marketing Monthly.[10] State commercial point source consumption is obtained from the NEDS point source data.[28]

Natural Gas

This section computes natural gas consumption as the total of natural gas and LPG consumption. The entire methodology for the estimation of consumption for each fuel is described in Anthracite Coal. By this methodology, total fuel consumption in therms is calculated for five commercial and institutional categories and then allocated to each fuel type. Natural gas consumption and LPG consumption are then converted from therms to 10^7 cubic feet and 10^3 gallons, respectively, using fuel equivalence factors of 9.69×10^{-6} and 1.05×10^{-3}.

State commercial area source consumption of natural gas and LPG are calculated separately. State natural gas consumption is the difference between the sum of the published statewide consumption of natural gas for commercial use and other gas sales in the state, and the state (natural gas) commercial/institutional point source consumption. State LPG consumption is determined as the difference between the state retail sales of LPG and the sum of state commercial/institutional point source consumption and normalized state residential LPG consumption. State consumption of natural gas and LPG by sources other than the five subcategories and normalization are computed by the same methods as in steps 4 and 5 in Anthracite Coal.

Normalized county consumption totals of natural gas and LPG are then summed. A heat equivalence factor of 0.0092 is used to convert 10^3 gallons of LPG to natural gas in 10^7 cubic feet.

Information concerning the state retail shipments of natural gas and LPG are found in DOE Natural Gas Annual[14] and API Sales of Natural Gas Liquids and Liquefied Refinery Gases,[15] respectively. State commercial point source consumption data are obtained from NEDS point source data.[28] Normalized residential consumption for LPG is obtained from the previous section entitled RESIDENTIAL FUEL Natural Gas.

Wood

No methodology has been developed for commercial/institutional wood use. Emissions from this source are considered negligible compared to those from other area sources.

Emission Factors

In the following section, sources of emission factors used for emissions estimation are presented for fuels for which consumption methodologies are available.

Anthracite Coal

Emission factors are obtained from AP-42[17] for the boiler types listed for SCC 1-03-001 in the NEDS point source data files.[28] The emission factors are then combined by weighting each factor in proportion to the total NEDS coal comsumption of each boiler type. For the purpose of this calculation, it is assumed that ash content is 11 percent and the sulfur content is 0.7 percent.[18]

Bituminous Coal

Weighted emission factors for boilers are obtained using emission factors from AP-42 and coal consumption from NEDS point source data[30] for SCC 1-03-002 and 1-03-003.[28] For SO_2, the emission factor is 36.19 pounds of SO_2 per ton of coal burned. Average sulfur content value is determined by weighted average of the sulfur content of each production district found in Coal Production.[19] District averages are then weighted according to shipment data for each 'district to destination' ("Other Consumers") contained in DOE Coal Distribution.[6] The control efficiency for particulates is calculated by updating the previous year's control efficiency.

Distillate Oil

Emission factors are taken directly from AP-42.[17] For VOC, the non-methane VOC emission factor is used. For SO_2, average sulfur content values for No. 1, No. 2, and No. 4 oils from Heating Oils[20] are weighted using commercial deliveries of oil type reported in Petroleum Marketing Monthly.[10]

Residual Oil

Emission factors are taken directly from AP-42.[17] Sulfur content values are obtained for No. 5 light, No. 5 heavy, and No. 6 fuel oils in Heating Oils.[20] A weighted average is calculated using No. 6 sulfur content and for the mean of No. 5 oil sulfur contents, assuming 13 percent and 87 percent of the fuel oil used is No. 5 and No. 6, respectively.[18]

Natural Gas

Emission factors for natural gas are obtained directly from AP-42.[17] For natural gas VOC, the non-methane VOC emission factor is used.

INDUSTRIAL FUEL

Area source emissions generated by the industrial sector which are not accounted by point source categories are discussed for the following fuel types: anthracite coal, bituminous coal, coal-oil-mixture, industrial coke, distillate oil, residual oil, natural gas, wood, and process gas. Methodologies for consumption and emission factor computation are presented as available.

Activity Levels

A procedure was developed by Walden[1] for the allocation of state industrial area source consumption of bituminous coal, distillate oil, residual oil, natural gas, and LPG. Anthracite coal, coal-oil-mixture, industrial coke, wood, and process gas methodologies have not been developed. Industrial area source consumption of these fuels are assumed to be neglible.

Bituminous Coal

The methodology for determining consumption by industrial area sources consists of two steps. As described in Walden,[7] county industrial fuel consumption for bituminous coal, distillate oil, residual oil, and natural gas are calculated, summed, and then normalized with state published values. Sources of inputs and normalization for each of the above fuel types are discussed within their respective sections.

The first step in the methodology is to determine industrial fuel consumed by the four fuel types by county. This is accomplished by adjusting county area source employment figures for SIC categories 20 through 39 by a fuel intensity factor. For the purpose of this calculation, county area source employment is defined as the difference between total county employment and point source employment for each SIC category. The fuel intensity ratio is a measure of fuel use intensity per employee which is determined by dividing the state consumption of fuel for each SIC category by the respective state employment. (If state data are not available, national data are used). County area source consumption is then summed for all counties to obtain state area source consumption by fuel type.

County consumption values are then normalized to agree with state level calculated industrial area source consumption values for each fuel type. Reported industrial area source consumption is calculated separately for each fuel type in each respective fuel section. For bituminous coal, this is the difference between the published total of coal shipments to the state for industrial consumption and the state industrial point source coal consumption.

Sources of information on county total and point source employment figures for SIC categories 20 through 39 for all fuel types are obtained from County Business Patterns.[22] Total industrial coal shipments to states for each year are found in DOE Coal Distribution.[6] Information concerning State consumption of bituminous coal by SIC category from the Annual Survey of Manufacturers[29] is used to calculate fuel intensity factors. State industrial point source data are taken directly from NEDS point source data.[28]

Diltillate Oil

County industrial consumption of distillate oil is estimated using the same methodology as described in Bituminous Coal. Normalization is accomplished by adjusting the sum of county consumption estimates with calculated state industrial area source consumption. Calculated area source consumption of distillate fuel is equal to the difference between the sum of the oil sales to industry and sales to oil companies, and the state industrial point source consumption.

State distillate oil sales to industry, and sales to oil companies are obtained from DOE Petroleum Marketing Monthly.[10] Residential consumption of oil is taken from the section entitled RESIDENTIAL FUEL Distillate Oil. Fuel consumption by SIC used in fuel intensity ratio calculations is obtained from the Annual Survey of Manufacturers.[29] State manufacturing and commercial employment data are found in County Business Patterns.[22] Industrial consumption of distillate oil by point sources is found in NEDS point source data.[28]

Residual Oil

County industrial consumption of residual oil is estimated using the same methodology as described in Bituminous Coal. County estimates are then summed to produce a state industrial estimate which is compared to published state consumption data.

Normalization is done by adjusting the sum of county consumption estimates with calculated state industrial area source consumption. Calculated area source consumption of residual oil is the difference between total state industrial consumption and industrial point source consumption. Total industrial consumption is defined as the sum of oil sales to oil companies, and oil sales to industry.

Industrial consumption of residual oil by point sources is obtained from NEDS point source data.[28] Oil sales information is taken from DOE Petroleum Marketing Monthly.[10] Fuel consumption by SIC used in fuel intensity ratio calculations is obtained from the Annual Survey of Manufacturers.[29] County Business Patterns[22] contains manufacturing employment data necessary for calculations.

Natural Gas

County industrial consumption of natural gas is estimated using the same methodology as described in Bituminous Coal. County estimates are then summed to produce a state industrial estimate which is compared to published state consumption data.

Area source consumption of natural gas is calculated as the sum of area source consumption of both natural gas and LPG. Area source consumption is the difference between total state sales of each fuel to industry and state industrial point source consumption for each fuel type.

Total state sales of natural gas and LPG are found in the Natural Gas Annual[14] and API Sales of Natural Gas Liquids and Liquefied Refinery Gases.[15] Fuel consumption by SIC used in fuel intensity ratio calculations is obtained from the Annual Survey of Manufacturers.[29] Industrial point source consumption for each fuel type is found in NEDS point source data.[28]

Emission Factors

On the following section, sources of the emission factors used for emissions estimation are presented for fuels for which consumption methodologies are available.

Bituminous Coal

Weighted emission factors are taken from NEDS point source data[28] for SCC 1-02-002. The value of the emission factor for SO_2 is 38.1 pounds of sulfur dioxide per ton of coal burned.[18]

The average sulfur content for shipments from each coal-producing state to other industrial users is taken from Coal Production[19] and weighted for each production district. District averages are weighted by shipments data from each 'district to a destination' as found in Coal Distribution.[6] The control efficiency for particulates is calculated by projecting the previous year's control efficiency.[18]

Distillate Oil

Emission factors are found in AP-42.[17] For VOC, the non-methane emission factor is used. For SO_2, the average sulfur contents for No. 1, No. 2 and No. 4 fuel oils are taken from Heating Oils.[20]

Residual Oil

Emission factors are found in AP-42.[17] For VOC, the non-methane emission factor is used. For SO_2, the average sulfur content for No. 6 fuel oil is obtained from Heating Oils.[20]

Natural Gas

Emission factors are assigned according to two use subcategories: boilers, and gas pipelines and plants. Boiler emission factors are obtained from AP-42[18] for natural gas-fired industrial boilers of the 10 to 100 million

BTU range. For gas pipelines and plants, emission factors are obtained for SCC 2-02-002-01 (Turbines) and SCC 2-02-002-02 (Internal Combustion Engines) from NEDS point source data.[28] For both categories emission factors are weighted according to the total NEDS boiler fuel consumed by each type.

SECTION 4
MOBILE SOURCES

Mobile sources which contribute to area source emissions are divided into the following five major categories: Highway Vehicles, Off-Highway Vehicles, Railroad Locomotives, Aircraft, and Marine Vessels. For each of the above categories, methodologies for activity level and emission factor estimation are discussed.

HIGHWAY VEHICLES

NEDS disaggregates motor vehicles into four categories on the basis of use and gross vehicle weight for the purpose of calculating emissions. Light duty gasoline vehicles are defined as gasoline powered passenger vehicles weighing 8500 pounds or less. Light duty gasoline trucks include gasoline cargo vehicles weighing 8500 pounds or less. Heavy duty vehicle categories separate diesel and gasoline powered trucks and buses weighing more than 8500 pounds. Motorcycles, light duty diesel vehicles and light duty diesel trucks were assumed to contribute little emissions relative to the above four categories when the allocation method was developed.

Fuel consumption and average fuel efficiencies are used to determine vehicle miles travelled (VMT) for four classes of average speed to reflect road usage, namely, limited access roads (55 mph), rural roads (45 mph), suburban roads (35 mph), and urban roads (19.6 mph). At the present time, NEDS calculates emissions for limited access roads, rural roads and urban road types.[30] Each speed class includes the following FHWA assigned functional classes.[31]

Limited Access Roads (55 mph)	Rural and Urban Interstate Rural and Urban Other Principal Arterials Other Freeways and Expressways Rural and Urban Minor Arterials
Rural (45 mph)	Rural Major Collector Rural Minor Collector Rural Local
Urban (19.6 mph)	Urban Collector Urban Local

For highway vehicles, activity levels include fuel consumption (10^3 gallons) by fuel type for each vehicle type and speed class specific annual vehicle miles travelled (VMT). Emission factors in grams per mile obtained from the execution of a mobile source model are applied so as to determine emissions for vehicle type and speed class.

Activity Levels

In the following sections, fuel consumption and VMT estimation procedures are discussed separately.

Light Duty Gasoline Vehicles (LDGV) and Light Duty Gasoline Trucks (LDGT)

Gasoline consumption of LDGV and LDGT is determined by allocating total state highway gasoline consumption to the county level based on a methodology developed by Walden.[7] County use of gasoline by LDGV and LDGT is obtained by subtracting county estimates of gasoline consumed by heavy duty gasoline vehicles (as computed in this area source section) from the total county consumption.

Total gasoline consumption reported for each state is allocated to counties by one of two methods depending on the availability of state submitted data for vehicle miles travelled in each county.[7]

(1) For states for which county level measured VMT data are available, the total state consumption is distributed to counties based on the proportion of county to state VMT totals.

(2) For states which do not report annual VMT by county, the number of cars and trucks less than 6000 pounds registered in each county is used for allocation. This is based on the assumption that the majority of the vehicle miles travelled by light duty vehicles are within the county of registration. The number of light duty vehicles is adjusted by multiplying the number of registrations by a

rural/urban miles to vehicle index. The index reflects data analyzed by Walden[7] which concluded that the number of miles travelled is directly proportional to the degree of ruralness of the county (as measured by the proportion of rural to total county population).

The light duty vehicle consumption estimate is then broken down into separate estimates for light duty gasoline vehicles (passenger cars) and light duty gasoline trucks based on registration data.

County consumption estimates for each vehicle group are then converted to total vehicle miles travelled using fuel efficiency figures in miles per gallon. Total VMT for each vehicle type are then used to calculate VMT for each of three speed classes (limited access roads, rural roads, and urban roads). The original methodology for computing speed class VMT was modified by GCA.[30] In the updated method, total state VMT for each speed class is allocated to the county level according to the miles of each road type constructed in the county relative to the miles of each type constructed in the State.

Total state highway gasoline consumption and state annual vehicle miles travelled are found in Federal Highway Administration Highway Statistics.[31] Rural/urban factors are presented for four different rural percentage groups of county population in Walden.[7] Fuel efficiency estimates are taken from calculations by NADB.[32] County level registrations are obtained from the R. L. Polk Company.[33]

Heavy Duty Gasoline Vehicles (HDGV)

County gasoline consumption by heavy duty vehicles is determined by calculating county estimates of gasoline consumed for each county by three truck weight classes (i.e., 6000 to 10,000 pounds, 10,001 to 19,500 pounds, and over 19,500 pounds) and institutional buses in methodology developed by Walden.[7]

To determine gasoline consumption by trucks, county truck registrations for each weight class are multiplied by the average annual miles travelled by each weight class in each state and divided by the national average weight class fuel efficiency (miles per gallon). Gasoline consumption by institutional buses is calculated using the number of state bus registrations and the average gasoline consumption (gallons per year); state gasoline consumption for buses is allocated to the county based on current county population.

County level truck consumption and bus consumption are then multiplied by the average fuel efficiencies (miles per gallon) and summed to yield total state VMT for HDGV. Total state HDGV VMT is allocated to county speed class based on the county miles of each road type for each speed class in the state.[30]

Total state highway gasoline consumption, and state average annual vehicle miles travelled are obtained in Federal Highway Administration Highway Statistics.[31] Average fuel efficiency is taken from calculations by NADB.[32] County population statistics are available from Current Population Reports.[12] County level registration data are obtained from R. L. Polk data.[33]

Heavy Duty Diesel Vehicles (HDDV)

The methodology for determining diesel fuel consumption of heavy duty vehicles differs significantly from the methods used for other vehicle types. Since HDDV behavior is often characterized by cross-country travel, much of the fuel consumption of these vehicles is accrued outside the county of registration. To account for this behavior, the methodology separates HDDV consumption into two consumption estimates based on long-range travel and short-range travel.[34]

By this method, published state consumption is allocated to the county level on the basis of total, out-of-state, and local VMT. From the data in the Truck Inventory and Use Survey (TIUS),[35] GCA extracted the annual miles travelled and percentage of the miles travelled outside the state for all diesel trucks weighing at least 8500 pounds (gross vehicle weight). VMT categories are estimated using the above data and the following equations:

Total VMT = annual miles X stratum expansion factor

Long Range VMT = annual miles X percent of travel outside state X stratum expansion factor

Short Range VMT = Total VMT - Long Range VMT

The stratum expansion factor is a ratio used to expand the vehicle data from the sample size in TIUS to each state's vehicle populations.[35] State long range totals are summed to form the national HDDV long range VMT pool.

The national long range VMT pool is then allocated to the county level according to the fraction of the total state mileage of the National Network located within each county line. The National Network is a set of highways on which large trucks are ensured travel rights. Since data are available on county roadway mileage by functional class, and the National Network is a subset of Federal Aid Primary (FAP) System, state totals of National Network mileages are allocated to counties on the basis of county mileage of each of the major FAP functional classes: Interstate, Major Arterials, and Freeways.

Short range VMT is allocated to the county level on the basis of truck registrations. Short range VMT and long range VMT are then totalled for each county and multiplied by the average fuel efficiency (miles per gallon) to obtain fuel consumption by HDDV.

Since the behavior of HDDV differs significantly from that of other vehicle types, VMT is allocated to speed classes (limited access, urban, and rural) in a different manner. Each county's HDDV long range VMT is assumed to occur on limited access roads; short range HDDV VMT is divided equally between rural and urban roads.

Total state highway diesel fuel consumption, registration data, and National Network mileage are taken from FHWA Highway Statistics.[31] County roadway mileages by functional class were obtained from ERT data.[36] VMT measurements are obtained from the Truck Inventory and Use Survey.[35] FAP fuel efficiency data are extracted from calculations by NADB.[32]

Emission Factors

Emission factors for highway vehicles are computed using EPA's MOBILE3 model.[37] The model is run with the following standard inputs to compute county-specific emission factors for each vehicle class:

1. County-specific vehicle registrations by model year and vehicle class, as obtained from R. L. Polk and Company;[33]
2. MOBILE3 default values for mileage accumulation distributions;
3. No use of special correction factors for air conditioning, vehicle load, trailer towing, or humidity;
4. VOC emission factors computed on a non-methane basis;
5. No modification of MOBILE3 standard trip/day or miles/day data; and
6. MOBILE3 default values for tampering rates (No credits for anti-tampering programs are considered.).

For each county, MOBILE3 scenario records are input to specify:

1. The location of the county in a low altitude or high altitude region (For California, the model is run for "low altitude" with modified basic exhaust emission rates by model year to correspond to California emission standards. These data were provided by the California Air Resource Board.[38]);
2. Average vehicle speeds of 55, 45 and 19.6 mph corresponding to the road categories for which VMT have been estimated for each county (For 19.6 mph roads, standard values of 20.6 percent of VMT accumulated in cold-start mode and 27.3 percent of VMT accumulated in hot-start mode are used.[37] For 55 mph roads, the percent of VMT accumulated in both cold and hot-start modes are assumed to be zero. For 45 mph roads, percentages for 1985 will be calculated when 1985 VMT data become available, by assuming the standard values for 19.6 mph roads for local rural roads and zero for rural collector roads.);
3. An annual average ambient temperature typical of a weather station near the centroid of a State[4] (The same temperature is used for all counties in a State.); and
4. The impact of county inspection/maintenance (I/M) programs (For counties where I/M programs are in effect, data to estimate the impact of such programs are supplied by the EPA Office of Mobile Sources.[39]).

OFF-HIGHWAY VEHICLES

Emissions from off-highway vehicles are generated by activities of gasoline and diesel vehicles which do not utilize road systems. Vehicles contributing to off-highway emissions are divided into six general categories: farm equipment, construction equipment, industrial equipment, motorcycles, lawn and garden equipment, and snowmobiles. While gasoline is consumed by all six categories, diesel fuel is utilized only by farm equipment, construction equipment, and industrial equipment.

Activity Levels

Off-highway consumption for each fuel type is determined by summing the consumption of each of the six general categories above. In general, consumption is estimated by one of the following methods:

- Apportionment of national fuel consumption to counties on the basis of employment, population, etc.
- Calculation of county or state totals by applying fuel consumption rates to average usage figures and equipment populations.

Consumption estimation methodologies are described for each category below by fuel type.

Farm Equipment

State consumption of gasoline and diesel fuel by farm equipment is apportioned to individual counties based on county tractor population data. To estimate state fuel consumption by farm equipment, consumption values are calculated separately for each of five subcategories: farm tractors, combines, motorized balers, forage harvesters, and general purpose large utility engines. The original algorithm for each subcategory developed by SWRI[40] was later revised by Walden.[1] Consumption by fuel type is calculated using subcategory state population, average annual usage (hours per year), and average hourly consumption by fuel type per unit (gallons per hour). For diesel fuel, the sum of the estimated fuel use for all subcategories is normalized to agree with published state totals for agricultural diesel fuel use found in DOE Petroleum Marketing Monthly.[10] Total state consumption is then allocated to the county level according to the ratio of county tractor population to state tractor population.

Average annual usage and average hourly consumption are extracted from the SWRI study.[40] With the exception of general purpose large utility engines, state and county equipment populations are obtained from Census of Agriculture-State and County Data.[41] Large utility engine populations are estimated in an algorithm developed by SWRI[40] which uses state tractor population and the number of irrigated and non-irrigated farms obtained from Census of Agriculture-Summary and State Data.[42]

Construction Equipment

The method used to determine consumption of gasoline and diesel fuel by construction equipment developed by SWRI[40] distributes national gasoline consumption to the county level. State fuel consumption is estimated by apportioning national fuel consumption to each state according to total non-building construction employment in each state. State totals for diesel fuel are normalized to agree with DOE published totals for construction equipment.[10] For the purposes of this algorithm, total non-building construction employment is the sum of the employment of heavy construction (SIC category 16) and special trade (SIC category 17) industries. County consumption of fuel is then allocated from state construction consumption on basis of county population.

Estimates of national gasoline consumption are provided by OAQPS data files of nationwide emissions[43] using emission and unit consumption data compiled in the SWRI Study.[40] For diesel fuel, published national totals are reported by DOE in Petroleum Marketing Monthly.[10] Annual employment data are extracted from the Bureau of Census County Business Patterns.[22] Population statistics utilized in county allocation are located in the Census of Housing.[2]

Industrial Equipment

The methodology developed by Walden involves apportioning national industrial fuel consumption according to relative differences in labor productivity of three industries.[1] The algorithm compares combined county employment to the combined national employment of manufacturing (SIC categories 20 through 39), mining, and wholesale trade industries. Resulting state totals for diesel fuel are normalized to agree with DOE fuel totals.[10]

Estimates of national fuel consumption are provided by OAQPS data files of nationwide emissions[43] using emission and unit consumption data compiled by SWRI.[40] For diesel fuel, published national totals are reported by DOE in Petroleum Marketing Monthly.[10] Total employment in manufacturing, mining, and wholesale trade is the sum of figures reported in Bureau of Census County Business Patterns[22] for Division D, Division B, and Major Group 50, respectively.

Motorcycles

SWRI developed an algorithm for estimating county level gasoline consumption based on population, state motorcycle registrations, average annual usage (miles per year) and average fuel consumption rate (gallons per mile).[40] Walden later refined the method, separating off-road and combined use motorcycles and weighting the distribution of the two types according to regional variations for allocation.[1]

State motorcycle vehicle registration data, national usage rate, factors for the two types of motorcycles, and national fuel consumption rate for both off-road and combination use motorcycles are available from FHWA Highway Statistics[31] and the 1985 Motorcycle Statistical Annual.[44] Current county population statistics are obtained from the Bureau of Census Current Population Reports.[12]

Lawn and Garden Equipment

The original methodology for allocation of national consumption of gasoline by lawn and garden equipment to individual counties was developed by SWRI.[40] Regression analyses yielded an algorithm in which county apportionment is based on the number of single-unit dwelling structures, the number of freeze-free days (i.e. minimum average temperature greater than 32°F), the fraction of national snow zone population in the county (all areas with an annual snowfall greater than 30 inches), snowthrower fuel consumption rate, average snow removal rate, and county snowfall.[40]

Annual weather data including freeze-free days and county snowfall are reported monthly for selected representative weather stations in each county in NOAA climatological data.[4] The number of dwelling units in single structures is available in Bureau of Census Census of Housing.[2] Current county population is available from Bureau of Census Current Population Reports.[12] National gasoline consumption was provided by NADB using calculations based on the SWRI study.[40]

Snowmobiles

County consumption of gasoline by snowmobiles is derived from the national snowmobile gasoline consumption total allocated on the basis of county snowmobile population. To estimate county level snowmobile population, a set of regression formulations developed by SWRI is used to relate the percent of state snowmobiles used in the county to population and snowfall.[40] To reflect the impact of population density on snowmobile usage, different algorithms are used to calculate usage in counties with population densities greater and less than 1000 per square mile. A factor reflecting the ratio of average county snowfall to snowfall received in the center of the state is included in these algorithms due to its signifiance in the regression analyses.

State snowmobile registration data are available by contacting the International Snowmobile Association.[45] Snowfall statistics for each county and the centroid county for each state are compiled by NOAA climatological data.[4] County population statistics are recorded in the Bureau of Census Current Population Reports.[12]

Emission Factors

Emission factors for each off-highway category by fuel use are discussed below with the exception of the factors used to determine VOC emissions.

For all gasoline-consuming categories, it is assumed that 0.918 of total hydrocarbon is reactive VOC. This fraction is based on VOC Species Data Manual, Profile 90-6021D.[46] For all diesel consuming categories, a value of 0.952 of total hydrocarbon is assumed to be reactive VOC based on Profile 90-7021.[46]

Farm Equipment

Emission factors for diesel and gasoline farm tractors and other farm equipment are obtained separately from AP-42.[17] Large utility equipment emission factors are also taken from AP-42.[17]

Construction Equipment

Emission factors from AP-42[17] are weighted separately for diesel fuel and gasoline equipment using consumption data from the Procedures Document.[18]

Industrial Equipment

Emission factors for industrial equipment are taken directly from AP-42.[17]

Motorcycles

Emission factors for gasoline motorcycles are determined utilizing the MOBILE2 program[47] with the following conditions:

1. County Altitude - Low
2. Vehicle Speed - 19.6 mph
3. Ambient Temp. - 57°F
4. Hot Start/Cold Start Percentage - Zero
5. All other variables - default values

Resulting emission factors in grams per VMT are converted to pounds per 10^3 gallons using a unit conversion factor of 20.8.[18]

Lawn and Garden Equipment

Emission factors for gasoline powered lawn and garden equipment are taken directly from the small general utility engines section of AP-42.[17]

Snowmobiles

Emission factors for gasoline powered snowmobiles are taken from AP-42.[17]

RAILROAD LOCOMOTIVES

This category includes fuel utilized by railroad locomotives and fuel used by railroad stations and workshops for space heating. The latter fuel consumption has been included primarily because it is difficult to separate from total railroad fuel use and is considered insignificant compared to locomotive consumption. The primary fuel consumed by railroad locomotives is distillate oil (diesel fuel). The activity level, measured in 10^3 gallons, is multiplied by emission factors to produce emissions estimates.

Activity Level

The methodology used to estimate distillate oil consumption involves the allocation of published state consumption of distillate oil by railroad locomotives to the county level on the basis of current population distribution.

Data on the use of distillate oil by railroads for each state are obtained from DOE Petroleum Marketing Monthly.[10] Population statistics are available from the Current Population Reports.[12]

Emission Factors

The emission factors for railroad use are taken from AP-42.[17]

AIRCRAFT

Emissions estimates for aircraft are divided into three-categories: civil aircraft, commercial aircraft, and military aircraft. Activity levels and emission factors, measured relative to units of aircraft landing and take-off cycles (LTOs) by county, are multiplied by emission factors to obtain emissions estimates.

Activity Level

Activity level is measured by LTOs using either operation records from county airports or aircraft registration data, depending on the location of FAA airports. For the purpose of these calculations, an operation, as defined by the FAA, constitutes either a take-off or landing.

- For counties with FAA regulated airports and/or military airports, LTOs are derived separately from reported operations for civil commercial and miltiary aircraft categories.
- For counties with no FAA regulated airports or military airports, all operations are assumed to involve civil aircraft only. The number of LTOs are derived using county aircraft registration data. It is assumed each aircraft performs 250-LTOs per year.

Locations of FAA and/or military airports are obtained from the FAA Air Traffic Activity Report[48] and the military air activity information.[49] For counties without FAA airports, the number of active civil aircraft registrations are found in the FAA Census of U.S. Aircraft.[50]

Emission Factors

Weighted average emission factors are computed for each type of aircraft within each aviation category. In some categories, flyings hours are used as a unit of measure assuming that the number of flying hours are proportional to

LTOs. Emission factors are then combined using aircraft type population data from Jane's [51] and FAA Aviation Forecasts[53] to form one factor for each pollutant.

Military Aircraft

Emission factors for each aircraft type are taken from AP-42.[17] Initial emission factors are averaged and weighted by usage and population data.[52] Number of flying hours for single-engine piston planes, multi-engine piston planes, turboprops, turbojets, rotocraft piston planes, and rotocraft turbine planes are obtained from FAA Aviation Forecasts.[53] Average emission factors are weighted by aircraft population data found in Jane's[51] and FAA Aviation Forecasts.[53]

Civilian Aircraft

Emission factors are determined by the same procedure as in Military Aircraft.

Commercial Aircraft

Emission factors for commercial aircraft are calculated separately for 2 groups, namely, air taxi and commercial service.

Air taxi emission factors are weighted averages of emission factors for turbojects, turboprops, and piston planes taken from AP-42.[17] Weighting is based on the number of aircraft from FAA Census of U.S. Civil Aircraft.[50]

Commercial service aircraft emission factors from AP-42[17] are updated and weighted from the previous year's data on LTO's from the NEDS Emission Factor File[54] and the FAA Census of U.S. Civil Aircraft.[50] The number of operations in the update year is estimated using number of aircraft in service for each of the following plane types: BAC 111, Boeing-707, Boeing 727, Boeing 737, Boeing-747, L1011, DC8, DC9, and DC10. The resultant value is compared with the reported update year value obtained from FAA Air Traffic Activity Report.[48] The weighting factors are applied to the emission factors to produce an average for all plane types.

MARINE VESSELS

Marine vessel categories for which emissions estimates are discussed include coal vessels, distillate oil vessels, residual oil vessels, and gasoline vessels. Consumption methodologies and emission factor derivation are presented for each category below.

Activity Level

In the following section, the methods for generating activity level estimates are discussed. Final estimates are measured in gallons of fuel consumed. Emissions from coal vessels have not been estimated because emissions from this source are considered negligible compared to other area sources.

Distillate Oil Vessels

Emissions are estimated for marine vessels which use distillate oil (diesel fuel). This category includes large cargo and passenger ships, oil tankers, tugboats, and other steamships and motorships that are known to consume distillate oil. The activity level, measured in 10^3 gallons, is multiplied by emission factors to obtain emissions estimates. The methodology currently used by NADB to determine the consumption of distillate oil by marine vessels requires the updating of the most recent year's estimate with fuel data obtained from "Fuel Use by Vessels Bunkering" in Petroleum Marketing Monthly,[22] excluding fuel used by ships outside the U.S. continental limits. County totals from the previous year are multiplied by the ratio of the state total for the current year to the state total for the previous year.

The original methodology developed by NADB estimated county level consumption based on number, type and size of ship, and time spent in port and underway.[55] Consumption by vessels at ports for which consumption data were available was assigned to the port county. The remaining fuel consumption was distributed to ports and waterways according to tonnage handled. Information on fuel sales to vessels was taken from Bureau of Mines Sales of Fuel Oil and Kerosene;[56] ship characteristics were obtained from Waterborne Commerce of the United States.[57]

Residual Oil Vessels

Emissions are estimated for marine vessels which use residual oil. This category includes large cargo and passenger ships, oil tankers, tugboats, and all other steamships and motorships that are known to consume residual oil. The activity level, measured in 10^4 gallons, is multiplied by emission factors to obtain emissions estimates.

The original methodology developed by NADB estimated county level residual oil consumption based on 1975 data concerning the number, type and size of ship, and time spent in port and underway.[55] Consumption by vessels at ports for which consumption data were available was assigned to the port county. The remaining fuel consumption was distributed to ports and waterways according to tonnage handled. The original methodology was based on fuel sales to vessels from Bureau of Mines Sales of Fuel Oil and Kerosene,[56] and ship characteristics from Waterborne Commerce of the United States.[57]

The methodology currently used by NADB to determine the consumption of residual oil by marine vessels requires the updating of the most recent year's estimate with data concerning residual oil use by bunkering vessels in Petroleum Marketing Monthly,[10] excluding fuel used by ships outside the U.S. continental limits. County totals from the previous year are multiplied by the ratio of the state total for the current year to the state total for the previous year. By this method, county allocation is based on the county distribution of the original data.

Gasoline Vessels

County marine consumption of gasoline is calculated using an algorithm developed by SWRI[41] and later modified by Walden[1] to account separately for inboard and outboard motor use. Using this method, state gasoline consumption figures are derived from state boat registration (inboard and outboard), and average fuel consumption for each boat type (gallons per hour). State consumption is then allocated to counties according to county inland water area, coastline and the number of warm months which are suitable for recreational boating activities. The number of warm months is assumed to be the number of months during which the monthly normal temperatures exceed 45°F for counties north of 43° latitude, 48°F for counties between 37° and 43° latitude, and 55°F for counties south of 37° latitude. Coastline is converted to inland water area using a factor which is the ratio of coastline and open water boating density to inland water area and inland boating density.

Boat registration data are obtained from National Marine Manufacturing Association Boating Registration Statistics.[58] Average fuel consumption for inboard and outboard motors are assumed to be 3.0 and 1.5 gallons per hour, respectively.[40] County inland water and coastline areas are available in Bureau of Census Area Measurement Report: U.S. Summary.[59] Weather data is found in NOAA climatological data.[4]

Emission Factors

In the following section, sources of emission factors are presented for categories for which activity level estimation methodologies are available.

Distillate Oil Vessels

Emission factors used for all pollutants except for VOC are the weighted averages of emission factors for commercial diesel motorships and steamships. Reactive VOC is determined to be a percentage of total VOC as taken from Profile 9-07-021 of the VOC Species Data Manual.[46] Each emission factor is derived in a series of calculations using emission factor data presented in AP-42.[17] For the purposes of these calculations the following assumptions are made:

a. Commercial vessel population is comprised of 75 percent motorship and 25 percent steamships.

b. Commercial steamships spend 80 percent of the time hotelling and 20 percent under full power.

c. Diesel steamships spend 20 percent of the time under auxiliary power and 80 percent underway.

Efforts are made to exclude operations conducted outside the continental U.S.

Residual Oil Vessels

Emission factors used for all pollutants except for VOC are the weighted average of the emission factors for commercial residual oil motorships and steamships. Reactive VOC is determined as a percentage of the total VOC as taken from Profile 1-01-004 of the VOC Species Data Manual.[46] Each emission factor is determined with AP-42[17] by the same procedure as in Distillate Oil Vessels using assumptions a and b.

Gasoline Vessels

Average weighted emission factors are based on the inboard and outboard motorboat registrations. Weighting accounts for higher fuel consumption per hour operation by inboard motors. For VOC, it is assumed that the reactive fraction is 0.9172 based on VOC Species Data Manual, Profile 9-06-021B.[46]

SECTION 5

SOLID WASTE DISPOSAL

The area source category for solid waste disposal includes on-site refuse disposal activities by residential, commercial/institutional, and industrial sectors. In this section, emissions from the disposal practices of open burning and on-site incineration are discussed separately. Solid waste generation in hundreds of tons is used as a measure of activity level.

ON-SITE INCINERATION

For the purposes of determining solid waste generated, on-site incineration is defined as disposal in a small incinerator. Using this definition, incineration encompasses the following types of disposal units: backyard burners, industrial incinerators, and incinerators used by food and department stores, hospitals, and schools. Since large municipal incinerators are usually classified as point sources, emissions resulting from disposal in this type of incinerator have not been included in this category.

Activity Levels

The quantity of solid waste generated by each sector was estimated for the base year 1976 using population statistics and per capita generation factors for each EPA region. The regional factors were derived from the following studies: 1968 Survey of Community Solid Waste Practices, Interim Report[60] and Preliminary Data Analysis.[61] Allocation was based on county population.

Since 1976, the previous year's estimates of waste generated by each sector have been updated each year by the same percentage as the relative national percentage increase or decrease in the amount of waste generated (or incinerated) by point sources in each respective sector.[28] For the commercial/institutional and industrial sectors, the annual increase or decrease in waste incinerated by SCC point source categories within each sector is used. The annual residential update factor is based on engineering judgement and calculations by NADB.

Adjustments are made to county estimates, based on information about specific point sources and data submitted by states. If a number of on-site incinerators have been identified as point sources, it may be appropriate to reduce or eliminate area source estimates. Also, it is important to note that estimates of waste generated that are submitted by the states replace the extrapolated data for the year it is submitted. Submitted data are then annually updated by the above method using the relative percentage increase in waste generated.

Previous estimates of waste generated are available from the NEDS point source data.[28] Annual national update factors are calculated using incineration data from National Air Pollutant Emission Estimates 1940-1984.[62]

Emission Factors

Emission factors taken from AP-42[17] are used with data from the Inventory of Intermediate Size Incinerators in the U.S.[63]

OPEN BURNING

For the purposes of estimated open burning practices, open burning refers to uncombined burning of wastes such as leaves, landscape refuse, and other rubbish. Large open burning dumps are usually included under point sources.

Activity Levels

The quantity of solid waste burned is computed by updating the previous year's waste generation for each sector. The update factor is determined by engineering judgement. Estimates of the quantity of solid waste burned in the most recent year are obtained from the NEDS point source data.[28] Generation factors were originally obtained from data in the 1968 Survey of Solid Waste Practices, Interim Report[60] and the Preliminary Data Analysis.[61] Allocation was based on county population.

Emission Factors

The emission factors for open burning of refuse and organic materials are taken directly form AP-42.[17]

SECTION 6

MISCELLANEOUS AREA SOURCES

Area sources which are not defined by STATIONARY SOURCES, MOBILE SOURCES, or SOLID WASTE categories are compiled in the miscellaneous area sources category. The importance of these area categories is that while total emissions from each source are relatively small compared to the major categories, emissions at a particular time may be significant.

As presented, identified miscellaneous area sources include: Gasoline Marketed, Organic Solvent Consumption, Unpaved Road Travel, Unpaved Air Strip Use, Construction, Miscellaneous Wind Erosion, Land Tilling, Forest Wildfires, Managed Burning, Agricultural Burning, Frost Control, and Structural Fires.

EVAPORATIVE LOSSES FROM GASOLINE MARKETING

This source category covers evaporative losses of volatile organic compounds from gasoline marketing operations such as filling losses from loading underground storage tanks at service stations, and spillage and filling losses from filling automobile tanks. Gasoline evaporative losses at refineries or bulk distribution terminals are not included. Emissions from refineries are assumed to be accounted for in point source categories. Emissions from bulk terminals and bulk plants are accounted for using methods described in ADDITIONAL AREA SOURCES.

The activity level for this category, measured by retail gas sales in 10^5 gallons, is multiplied by emission factors to generate emissions.

Activity Level

Retail sales of gasoline include all sales of gasoline for highway use, aviation use, and for use by the construction equipment, industrial equipment, and farm equipment off-highway subcategories. County retail gas sales are used directly when reported by states. For counties for which retail sales of gas are not compiled, sales to the above user categories are estimated separately and summed to generate total county sales.

State retail sales of gasoline for highway and marine use are allocated to each county according to the county's proportion of the statewide gross dollar receipts from gasoline service stations. Published state aviation retail sales of gasoline are allocated to the county according to the total LTO cycles in the county for each of the military, civilian, and commercial aircraft categories.

County retail sales of gasoline for off-highway sources are assumed to be the same as consumption derived in the activity levels section of Farm Equipment, Construction Equipment, and Industrial Equipment in OFF-HIGHWAY SOURCES.

If not provided by individual states, retail sales of gasoline for each category are obtained from Census of Retail Trade.[64]

Emission Factors

Emission factors are obtained from AP-42[17] and weighted according to the national percentage of each type of filling practice used. For VOC, the non-reactive VOC emission factor is used.

EVAPORATIVE LOSSES FROM ORGANIC SOLVENT CONSUMPTION

The following area source category documents the estimation procedures for evaporative losses of volatile organic compounds from solvent usage by area sources. Organic solvent usage is divided into six categories: dry cleaning operations, degreasing operations, surface coating application operations, printing, rubber and plastics, and other miscellaneous uses. In each category, usage of specific solvents is identified and enumerated to compute total solvent usage in tons per year.

Activity Levels

The methodology developed by Walden[1] for allocating organic solvent consumption by county consists of apportioning national consumption of seventeen primary solvent groups by major user category according to county population or user category employment data. User categories are listed in Table 1. Two of the major user categories, Surface Coatings and Other Uses, are further classified into subcategories as shown. Table 2 contains a list of the primary solvent groups used to determine losses from organic solvent consumption. The category "Special Naphthas" includes the aliphatic naphthas such as V. M. & P. naphthas, stoddard solvents, rubber solvents and mineral spirits.

In the algorithm developed by Walden,[1] national consumption of the primary solvent groups is distributed to each of the user categories according to the percentage of total solvent consumption used by the user category. Percentage usage obtained from published sources is compiled for each user category in Table 3. National area source solvent use estimates are determined by subtracting point source solvent use or emissions for each user category from total solvent use for each user category.

County consumption for each solvent group and user category is then computed by allocating calculated national area source consumption on the basis of applicable county SIC area source employment or population as shown in Table 1. For example, in the degreasing processes use category, total solvent use is allocated to each county in proportion to the county area source

TABLE 1: USER CATEGORIES

User Categories	Population or Employment Data by SIC Used for County Allocation
Surface Coatings	
Architectural Coatings and Traffic Paint	County Population
Auto Refinishing	7535 (Paint Shops)
Automotive	371 (Motor Vehicles)
Wood Furniture and Fixtures Metal Furniture and Fixtures	25 (Furniture and Fixtures)
Metal Containers Sheet Strip and Coil	34 (Fabricated Metal Products)
Appliances Machinery and Equipment	35 and 36 (Machinery, Electrical Equipment and Supplies)
Paper Coating	26 (Paper and Allied Products)
Factory-Finished Wood	243, 244 (Millwork, Plywood-Related Supplies, Wood Containers)
Transportation (Non-Auto)	37 (Transportation Equipment) Less 371 (Motor Vehicles) and 373 (Shipbuilding Repair)
Electric Insulation	36 Electrical Equipment and Supplies)
Other, Exterior, Interior	19-39 (Total Manufacturing)
Marine	373 (Shipbuilding and Repair)
Degreasing	34-39 (Metal Products, Machinery, Transportation Equipment, Instruments, Miscellaneous)
Dry Cleaning	2 x 7216, Plus 7215 and 7218 (Dry Cleaning and Combination with Wet Laundering)
Printing	264, 265, and 27 (Paper Products, Containers, Printing and Publishing)
Rubber and Plastics	30 (Rubber and Plastics)
Other Miscellaneous Use	1/2 of 19-39 Employment + 1/2 County Employment

TABLE 2: ORGANIC SOLVENTS

Special Naphthas
Perchloroethylene
Ethanol
Trichloroethylene
Isopropanol
Acetone
Glycol Ethers
Cyclohexanone
Methyl Ethyl Ketone
Ethyl Benzene
Propylene Glycol
Methanol
Butyl Acetate
Ethyl Acetate
Butyl Alcohols
Methyl Isobutyl Ketone

Monochlorobenzene
o-Dichlorobenzene
p-Dichlorobenzene

TABLE 3. 1985 ORGANIC SOLVENTS BY END USE CATEGORY (%)

SOLVENT	Consumption (MM lbs)	Surface Coating	Degreasing	Drycleaning	Graphic Arts	Rubber/ Plastic	Misc. Industry	Other
Special Napthas	7364	48.7	6.7	2.0	6.4	9.6	7.1	10.7
Perchloroethylene	595		10.0	53.0				4.0 *
Ethanol	9087						26.0	
Trichloroethylene	180		80.0					5.0 *
Isopropanol	1177	15.0					9.0	37.0
Acetone	1877	17.0						11.5 *
Glycol Ethers	385 ***	43.0					10.0	
Cyclohexanone	40 ***						5.0	
Methanol Ethyl Ketone	508	69.0			4.0		10.0	
Ethyl Benzene	6700							0.5
Propylene Glycol	447					54.0	4.0	6.0
Methanol	12,197						8.0	15.0
Butyl Acetate	101	65.0			5.0			3.0
Ethyl Acetate	214	41.0				8.0		13.0
Butyl Alcohols	886	15.5					1.8	1.3
Methyl Isobutyl Ketone	148	65.0					8.0	18.0
Monochlorobenzene	233		21.0 **				21.0 **	11.0 *
o-Dichlorobenzene	45						25.0	5.0 *
p-Dichlorobenzene	64					23.0		46.0

* Not identified as solvent or non-solvent other.

** Equally distributed where unspeciated.

*** Consumption = Production + Imports - Exports (from Chemical Products Synopsis).

employment for SIC groups 34 through 39. Area source employment is determined by subtracting point source employment from total county employment for each SIC category. For dry cleaning applications, the countywide allocation is made on the basis of total employment in SIC groups 7215, 7216, and 7218. In the category "Other Miscellaneous Solvent Use," county allocation is based on one-half county population plus one-half total industrial employment. To reflect the unequal solvent use in particular establishments within SIC groups, consumption is multiplied by a factor which compares the number of individuals in the county in each area source user category to the number of individuals in the nation in each area source user category. County consumption of each solvent type is then summed for each county to yield a total county consumption.

The reported national consumption of each solvent is extracted from DOE Petroleum Supply Annual[65] and ITC Synthetic Organic Chemicals.[66] The percentage of each solvent consumed by each solvent-user category is obtained from Chemical Products Synopsis[67] and "Chemical Profiles".[68] Total employment is obtained from County Business Patterns.[22] Point sources employment is estimated using plant data from NEDS point source file[28] and employment data from County Business Patterns.[22] County population is obtained from County Population Reports.[12]

Emission Factors

Emission factors for release of VOC assume complete evaporation of all miscellaneous organic solvents (2000 pounds VOC per ton of solvent used).[18]

UNPAVED ROADS

Vehicle traffic over unpaved roads, parking areas, and recreational areas generates fugitive dust emissions which are estimated in NEDS. Primary factors which affect the amount of dust generated are vehicle speed, surface type, wind speed, surface moisture, and type of vehicle. Methodologies for the estimation of activity level measured in vehicle miles travelled (VMT) and for emission factor derivation are described below.

Activity Level

The methodology developed by NADB to determine the county VMT on unpaved roads is based on regression analysis of data collected for VMT per county and mileage of unpaved roads per county.[69] County road mileages for this study were obtained from state transportation or highway departments. VMT was found to be dependent on the county population and mileage of unpaved roads in the county.

County population statistics are taken from County Population Reports.[12] State road mileage for surface types A through E are published annually by FHWA Highway Statistics.[31]

Emission Factors

Emission factors are computed using the equation in AP-42.[17] The aerodynamic particle size multiplier corresponding to the inclusion of particles less than or equal to 30 micrometers was used. Average vehicle speed is assumed to be 40 miles per hour.[69] Road surface material, silt content, and the number of days with precipitation are taken from MRI.[70] Mean vehicle weight for 4-wheeled vehciles is assumed to be 3 tons.[69]

UNPAVED AIRSTRIPS

Unpaved airstrip emissions are affected by the same primary factors as unpaved roads. Fugitive emissions from unpaved airstrip use are measured by annual landing-take off (LTO) cycles on unpaved airstrips in each county. The activity level estimate derived for each county in the NEDS is multiplied by an adjusted emission factor to obtain a particulate emissions estimate.

Activity Level

MRI[70] developed a methodology to measure the activity level by LTO cycles at unpaved airstrips within the county. Unpaved airstrip LTOs are determined by identifying all airports which have airstrips made of dirt, sand, gravel, or gravel pavement, excluding airports with no based aircraft, airports no longer in operation, helioports, and seaplane bases. The number of aircraft based in each airport is tallied for each county and then multiplied by 250. During the MRI study, local FAA officials estimated the typical number of LTOs of a based aircraft at small airport facilities is 250 per year.

Emission Factors

The particulate emission factor was obtained from AP-42.[17] For the purposes of these calculations, average LTO speed is estimated at 40 miles per hour, the length of the runway to complete on LTO is one mile, and the wind-erosion multiplier equals 2. Surface texture is determined for each state based on the number and type of non-surfaced airstrips and average soil silt content for each county.[70]

CONSTRUCTION

Road and building construction activities generate particulate emissions. Principal activities in construction which cause dust emissions are land clearing, excavation, and vehicle traffic around the construction site. Variables known to affect emissions are soil type, moisture, wind speed and type of operations on-site. At present, no methodology is available to estimate activity level on the county level. However, emission factors are available from AP-42.[17]

MISCELLANEOUS WIND EROSION

In some areas, large dust emissions are generated as a result of windblown dust. At present, no methodology to estimate activity levels on a county basis is available. No emission factors are available.

LAND TILLING

Fugitive dust emissions result from various soil preparation operations which include rough plowing, mulch plowing, and the cutting of narrow slits into the sod for seed and/or fertilizer. Variables known to affect the quantity of dust generated are soil type, surface moisture, resulting tool speed, type of equipment, and wind speed. However, no methodology has been developed to adequately estimate emissions. For previous inventories, activity levels were estimated using the number of acres tilled as obtained from the Census of Agriculture.[41] It was assumed that each acre of harvested cropland is tilled three times per year.[55] The resultant activity levels were reported in thousands of acres. The particulate emission factor is found in AP-42.[17]

FOREST WILDFIRES

Each year emissions are generated by forest wildfires covering large tracts of forested land. For this category, emission estimates are generated by multiplying the number of acres burned per county by a fuel loading factor and then the emission factor.

Activity Level

In the original methodology, IIT allocated state estimates of wildfire activity to the county level on the basis of forest acreage per county. IIT obtained wildfire statistics, reported in number acres burned, from contact with State forestry officials and from State land usage maps for the base year of 1974.[71] Since 1974, the NEDS wildfire activity level for each county from the previous year has been updated with wildfire statistics from the U.S. Forest Service.[72] Regional fuel loading factors in tons per acre for each EPA region from AP-42[17] are applied to state averages within each region to yield tons consumed.

Emission Factors

All emission factors except VOC are taken directly from AP-42.[17] For VOC, it is assumed that 79.7 percent of the total VOC by weight is reactive.[18]

MANAGED BURNING (SLASH/PRESCRIBED BURNING)

Managed burning activities included in this area source category are slash burning and prescribed burning. In slash burning operations, wastes from logging operations are burned under controlled conditions to reduce fire hazard and remove brush considered to serve host to destructive insects. Prescribed burning is used as a forest management practice to establish favorable seed-beds, remove competing underbrush, accelerate nutrient cycling, control tree pests, and contribute other ecological benefits.

For this category, emissions estimates are generated by multiplying the number of acres burned in each county by a fuel loading factor and the emission factor for each pollutant.

Activity Level

Original state estimates of acreage consumed by both managed burning techniques were determined by IIT for the NEDS inventory year of 1974.[71] Individual state officials and the U.S. Forest Service were contacted to provide estimates of acreage burned, burning technique, and fuel loading ratios. The 1985 NAPAP inventory utilizes state data generated for 1974 which was allocated to the county level according to forest acreage per county as obtained from contact with local officials or state land usage maps. If not provided, fuel loadings for slash burning and prescribed burning are 75 tons per acre and 3 tons per acre, respectively.[55]

Emission Factors

Particulate and CO emission factors are obtained from the Source Assessment.[73] SO_2 and NO_x emission factors are taken directly from AP-42.[17]

AGRICULTURAL BURNING

This miscellaneous area source category estimates emissions from agricultural burning practices routinely used to clear and/or prepare land for planting. Specific operations include grass stubble burning, burning of agricultural crop residues, and burning of standing field crops as part of harvesting (e.g. sugar cane). Emissions estimates are generated by multiplying the number of acres burned in each county by a fuel loading factor and the emission factor for each pollutant.

Activity Level

The original methodology developed by IIT Research[71] estimated the 1974 activity level in terms of acres burned per state. It is assumed that the total quantity of agricultural products burned in 1974 is the same quantity which will be consumed by fire each year. If no specific crop data were available, it was assumed that the number of acres burned annually are divided equally between sugar cane and field crops.[18] For the purposes of these calculations, fuel loadings for grass burning are 1 to 2 tons per acre; for sugar cane burning, fuel loadings range from 6 to 12 tons per acre.[55]

Emission Factors

Emission factors are taken from the Procedures Document[18] and AP-42.[17]

FROST CONTROL (ORCHARD HEATERS)

Orchard heaters are used to control frost, particularly by citrus grove operators. Variables known to affect the generation of emissions from this area source include the total number and type of orchard heaters, the number of units in operation at one time, and the amount of time each unit is used each night.[55] Because the above data have not been available to date and emissions from this source are considered negligible compared to other area sources, no methodology has been developed to estimate activity levels. Emission factors are found in AP-42.[17]

STRUCTURAL FIRES

Structural fires have been included in the NEDS because building fires have been identified in the production of short-term emissions of air contaminants. Activity level for this category, measured by the total number of fires per county, is multiplied by a loading factor and the emission factor to obtain emissions estimates.

Activity Level

The total number of building fires is obtained from the most recent statistics from the National Fire Protection Association.[74] In absence of county level allocation data, it is assumed, based on the nationwide figures given by the above reference, an average of four fires per 1,000 population occur each year. Estimates of the material burned is obtained by multiplying the number structural fires by a fuel factor of 6.8 tons of material per fire.[18]

Emission Factors

Emission factors are taken from the OAQPS Technical Tables.[75]

SECTION 7

ADDITIONAL AREA SOURCES

The 1985 NAPAP inventory will provide detailed county level VOC emissions estimates for additional area sources which previously have not been included in the NEDS area source categories. In this section, methods have been developed for many categories which have been traditionally considered point source categories such as Bakeries and Synthetic Fiber Manufacturing. These categories were included to reconcile the difference between their total emissions reported in the National Air Pollutant Emissions Estimates 1940-1984[75] and emissions already accounted for by the NEDS point source data files.[28] The remaining categories such as Publicly-Owned Treatment Works (POTWs) and Hazardous Waste Treatment Storage and Disposal Facilities (TSDFs) have been included due to the difficulty in measurement of emissions from a specific point (e.g., aeration basin). Because the additional categories are considered to generate significant VOC emissions, existing methodologies and data used by NEDS have been improved to provide accurate emissions estimates.

In this section, methodologies for estimating VOC emissions developed by GCA are presented for the following area sources: publicly owned treatment works (POTWs); hazardous waste treatment, storage, and disposal facilities (TSDFs); fugitive emissions from synthetic organic chemical manufacturing; bulk terminals and bulk plants; fugitive emissions from petroleum refining operations; process emissions from bakeries, pharmaceutical, and synthetic-fiber manufacturing; crude oil and natural gas production fields; and cutback asphalt paving operations.

For most categories, national VOC emissions are allocated to the county level to produce county VOC emissions estimates. Activity levels, emission factors, and control efficiencies are used to determine emissions for the remaining sources.

PUBLICLY OWNED TREATMENT WORKS (POTWs)

In the February 1986 Report to Congress on the Discharge of Hazardous Waste to Publicly Owned Treatment Works, the U.S. EPA Office of Water Regulations and Standards estimated that between 14 and 25 percent of all volatile pollutants discharged to POTWs are stripped to the ambient air. This corresponds to a national VOC emissions level between 12,900 and 23,200 metric tons from POTWs annually.[76] It has also been found that the range in VOC emissions potential is directly dependent on the level of acclimation of the POTW treatment system to the influent chemical constitution and concentration. Due to the variability in the percentage of industrial flow and chemical content reflected by POTW influent wastestreams, it is assumed that POTW treatment systems remain unacclimated. Therefore, the national VOC emissions level of 23,200 metric tons estimated for unacclimated treatment systems has been selected for use in the calculation of county VOC emissions in the 1985 NAPAP inventory.

The concentration of volatile organic compounds found in the POTW influent has been found to be directly proportional to the industrial contribution to a POTW. Additional research has also shown that for many conventional and priority pollutants, as influent concentrations increase, effluent concentrations also increase.[77] This implies that the removal mechanisms for these pollutants are relatively constant and that only a percentage of incremental loadings are removed by POTWs. Based upon the above findings, the national VOC emissions estimate for unacclimated treatment systems is allocated to the county level based upon the percentage of industrial flow per county. Industrial flow data are readily available from the EPA Office of Municipal Pollution Control biennial assessment of the wastewater treatment needs in the United States.[78]

National VOC emissions from POTWs are allocated to the county level by obtaining the total industrial flow for each county as a percentage of the total industrial flow for the nation. The total VOC emissions from POTWs for the nation are estimated in the EPA Domestic Sewage Study.[76]

HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES (TSDFs)

The EPA Office of Air Quality Planning and Standards is currently engaged in activities to study the characteristics and impacts of air emissions from TSDFs. The Emission Standards and Engineering Division (ESED) is in the process of developing national VOC emissions estimates for TSDFs based on facility-specific process descriptions, waste characterization and quantities, and VOC speciation contained in the Hazardous Waste Data Management System (HWDMS).[79] In general, emissions from each plant process at a TSDF are summed to form the national emissions estimates. Speciated emissions from each plant process are calculated as the quantity of a specific waste handled multiplied by a process specific emission factor. Process specific emission factors are obtained from the Background Information Documents for TSDFs.[80]

Using the same method and data from HWDMS, county emission estimates for 10 species of VOCs will be calculated as the sum of respective speciated VOC emissions generated by all TSDFs located within each county.

FUGITIVE EMISSIONS FROM SYNTHETIC ORGANIC CHEMICAL MANUFACTURING

The synthetic organic chemical manufacturing industry (SOCMI) has been found to contribute significant fugitive VOC emissions. In the following section, county emissions estimates are obtained by allocating national emissions estimates to the county level using employment data.

The fugitive emissions from synthetic organic chemical manufacturing have been estimated by the EPA Office of Air Quality Planning and Standards based on national production data for the manufacture of petrochemicals.[75] Another study developed an industry emission factor which has been established for the purpose of estimating the fugitive VOC emissions.[81]

Assuming that the potential for fugitive emissions (i.e., the number of pumps, valves, flanges, etc.) increases with the number of employees, the national VOC emissions are allocated to specific counties based on the ratio of the county to national employment in SIC category 2869. Current employment data are obtained from Bureau of Census County Business Patterns.[22]

Currently, NEDS point source entries under several Source Classification Codes (SCCs) account for a portion of these fugitive emissions. These are 3-01-800 (General Processes-Fugitive Leaks), 3-01-888 (Fugitive Emissions-Not Classified) and a large number of chemical production-specific SCC's designated as Fugitive Emissions: General.[28] The total VOC emissions for these SCCs are totalled by county and then subtracted from the national emissions estimate to remove the potential for double counting of emission sources.

This method of emission allocation presents a potential problem of developing negative area source emissions estimates for counties that have a greater level of point source VOC emissions reported in NEDS than the overall emission level allocated from the national fugitive VOC emissions estimate. To address this problem, it is assumed that the area source SOCMI fugitive VOC emissions for any county exhibiting negative area source emission levels are adequately represented by point source VOC emissions data reported in NEDS. To remove the potential of double counting emission sources, the national sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative proportion of employment for SIC category 2869 located in each.

BULK TERMINALS AND BULK PLANTS

To determine county estimates, GCA allocates national bulk terminal and bulk plant emissions data to the county level in three steps. The methodology uses national VOC emissions estimates for non-NSPS gasoline bulk terminals and bulk plants developed by the EPA Office of Air Quality Planning and Standards based on total annual throughput.[75] This study includes the use of VOC control efficiencies and emission factors based on throughput for both transfer and storage operations. The VOC emission control is assumed to be negligible at bulk plants.

Assuming that the potential for VOC emissions (i.e., the size of storage and transfer operations) increases with the number of employees, the national VOC emissions estimate is allocated to the county level based on the percentage of national employment in SIC category 5171 located in each county. County employment statistics are taken from Bureau of Census County Business Patterns.[22]

Currently, NEDS accounts for a portion of these emissions in the point source data files for SCC 4-04-001 (Bulk Terminals) and SCC 4-04-002 (Bulk Plants).[28] The VOC county emissions totals for each of these SCCs are subtracted from the portion of the corresponding national VOC emissions estimate to avoid double counting VOC emissions for these sources. The difference represents the VOC emissions in each county not accounted for as point sources in NEDS which are attributed to area sources.

The potential problem of developing negative area source emissions estimates for counties that have a greater level of point source VOC emissions reported in NEDS than the overall emission level allocated from the national VOC emissions estimate, is addressed by assuming that the VOC emission levels for these counties are adequately represented by the point source VOC emissions data reported in NEDS. To remove the potential of double counting emission sources, the sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative proportion of employment for SIC category 5171 located in each.

FUGITIVE EMISSIONS FROM PETROLEUM REFINERY OPERATIONS

In the following section, the methodology developed by GCA is documented for petroleum refinery operations. Using this method, national emissions data are allocated to each county based on refinery capacity data published in DOE Petroleum Supply Annual.[65]

Annual VOC emissions estimates for petroleum refinery operations have been developed by the EPA Office of Air Quality Planning and Standards (OAQPS) using capacity or production data.[75] Assuming that these national VOC emissions estimates represents the sum of the fugitive and point source emissions for refinery processes, the quantification of fugitive emissions is achieved by subtracting the total county point source VOC emissions for SCC categories 3-06-004 through 3-06-888 (Refinery Processes, excluding process heaters and catalytic cracking units) listed in NEDS[28] from the total emissions estimated for petroleum refinery processes in each county, respectively. This difference represents the portion of petroleum refinery operations VOC emissions attributed to area sources in each county.

The potential problem of developing negative area source emissions estimates for counties that have a greater level of VOC emissions reported in NEDS than the emission level allocated from the national VOC emissions estimate, is addressed by assuming that the VOC emission levels for these counties are adequately represented by the point source VOC emissions data reported in NEDS. To remove the potential of double counting emission sources, the sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative percentage of refinery capacity represented by each.

PROCESS EMISSIONS FROM BAKERIES

A methodology for estimating process emissions from bakery operations has been developed by GCA which allocates national emissions estimates to the county level based on employment data as described below.

Annual VOC emissions estimates from bakery operations have been developed by the EPA Office of Air Quality Planning and Standards (OAQPS).[75] The allocation of this national VOC emissions estimate to specific counties is based upon the county employment census data for SIC categories 2051 and 2052. Assuming that the potential for area source emissions increases with the number of employees, the national VOC emissions estimate is distributed to specific counties relative to the percentage of the national employment for SIC categories 2051 and 2052 located in each county. County employment data are available in Bureau of Census County Business Patterns.[22]

To avoid double counting the VOC emissions from major point sources, the total county point source VOC emissions for SCC 3-02-032 (Bakeries) listed in NEDS[28] are subtracted from the national VOC emissions estimate allocated to each county. This difference represents the portion of bakery operations VOC emissions attributed to area sources.

The potential problem of developing negative area source emissions estimates for counties that have a greater level of point source VOC emissions reported in NEDS than the emission level allocated from the national VOC emissions estimate, is addressed by assuming that the VOC emission levels for these counties are adequately represented by the point source VOC emissions data reported in NEDS. For these instances, the sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative proportion of employment for SIC categories 2051 and 2052 located in each.

PROCESS EMISSIONS FROM PHARMACEUTICAL MANUFACTURING

Emissions are known to be released from process operations during the manufacture of pharmaceutical products. Although the magnitude of emissions varies widely within and among operations, the following unit operations have been identified as contributing to process emissions: dryers, reactors, distillation units, filters, extractors, centrifuges, and crystallizers.[82] In the following section, county estimates of the above emissions are determined using a methodology developed by GCA.

Annual VOC emissions estimates from pharmaceutical manufacturing operations have been developed by the EPA Office of Air Quality Planning and Standards (OAQPS).[75] The allocation of this national VOC emissions estimate to specific counties is based upon the county employment census data for SIC category 2834. Assuming that the potential for area source emissions increases with the number of employees, the national VOC emissions estimate is distributed to specific counties relative to the percentage of the national employment for SIC category 2834 located in each county. Employment statistics for SIC category 2834 are obtained from Bureau of Census County Business Patterns.[22]

To avoid double counting the VOC emissions from major point sources, the total point source VOC emissions for SCC 3-01-060 (Pharmaceutical Preparations) listed in NEDS[28] for each county are subtracted from the national VOC emissions estimate allocated to each county, respectively. This difference represents the portion of pharmaceutical manufacturing operations VOC emissions attributed to area sources.

The potential problem of developing negative area source emissions estimates for counties that have a greater level of point source VOC emissions reported in NEDS than the emission level allocated from the national VOC emissions estimate, is addressed by assuming that the VOC emission levels for these counties are adequately represented by the point source VOC emissions data reported in NEDS. For these instances, the sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative proportion of employment for SIC category 2834 located in each.

PROCESS EMISSIONS FROM SYNTHETICS-FIBERS MANUFACTURING

The methodology used to estimate process emissions from synthetic-fibers manufacturing has been developed by GCA. In general terms, national emissions estimates are allocated to the county level based on employment data as outlined in this section.

Annual VOC emissions estimates from synthetic-fibers manufacturing operations have been developed by the EPA Office of Air Quality Planning and Standards (OAQPS).[75] The allocation of the national VOC emissions estimate to specific counties is based upon the county employment census data for SIC categories 2823 and 2824. Assuming that the potential for area source emissions increases with the number of employees, the national VOC emissions estimate is distributed to specific counties relative to the percentage of the combined national employment for SIC categories 2823 and 2834 located in each county. Employment data are obtained from Bureau of Census County Business Patterns.[22]

To avoid double counting the VOC emissions from major point sources, the total point source VOC emissions for SCC 3-01-024 (Synthetic Organic Fiber Production) and 3-01-025 (Cellulosic Fiber Production)) listed in NEDS[28] for each county are subtracted from the national emissions estimate allocated to each county, respectively. This difference represents the portion of synthetic-fibers manufacturing operations VOC emissions attributed to area sources.

The potential problem of developing negative area source emissions estimates for counties that have a greater level of point source VOC emissions reported in NEDS than the emission level allocated from the national VOC emissions estimate, is addressed by assuming that the VOC emission levels for these counties are adequately represented by the point source VOC emissions data reported in NEDS. For these instances, the sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative proportion of employment of SIC categories 2823 and 2824 located in each.

CRUDE OIL AND NATURAL GAS PRODUCTION FIELDS

Crude oil and natural gas production fields have been identified as releasing significant VOC emissions. For the 1985 inventory, previously calculated national emissions estimates are allocated to each county based on State annual production and county employment.

Annual VOC emissions estimates for crude oil and natural gas production have been developed by the EPA Office of Air Quality Planning and Standards.[75] The allocation of the national VOC emissions estimates for crude oil and natural gas production to specific counties is based on annual State production statistics and county employment census data for SIC category 1310. State-specific production figures allow for the distribution of the national VOC emissions to the State level in proportion to the volume of State annual production. State-specific production figures for crude oil and natural gas are available in the Petroleum Supply Annual[65] and the Oil and Gas Journal,[83] respectively. Each State's VOC emissions potential is then allocated to specific counties relative to the percentage of the State employment for SIC category 1310 located in each county. Employment data are found in Bureau of Census County Business Patterns.[22]

A portion of the VOC emissions for these sources are currently accounted for in NEDS point source data files[28] for SCC 3-10-001 (Crude Oil Production) and SCC 3-10-002 (Natural Gas Production). To avoid double counting the VOC emissions for crude oil and natural gas production fields, the total point source VOC emissions listed in NEDS for these two industries are subtracted from their respective national estimates. The difference represents the VOC emissions attributed to area sources associated with crude oil and natural gas production.

The potential problem of developing negative area source emissions estimates for counties that have a greater level of point source VOC emissions reported in NEDS than the emission level allocated from the national VOC emissions estimate, is addressed by assuming that the VOC emission levels for these counties are adequately represented by the point source VOC emissions data reported in NEDS. For these instances, the sum of all negative emissions is reallocated to the counties exhibiting positive emission levels based on the relative proportion of employment for SIC category 1310 located in each.

CUTBACK ASPHALT PAVING OPERATIONS

Cutback asphalt paving operations are known to generate significant emissions. For this category, State activity level is multiplied by an emission factor and then allocated to the county level using county employment data.

State VOC emissions for cutback asphalt paving operations are calculated by multiplying the activity level, measured in total quantity of cutback asphalt sales, by an emission factor. An emission factor in kilograms of VOC per ton of asphalt used has been established by the EPA Office of Air Quality Planning and Standards which assumes complete evaporation of all organic solvents used in paving operations.[75]

The cutback asphalt sales information provided by The Asphalt Institute is organized by state and district.[84] The state emissions totals are then allocated to specific counties relative to the percentage of the state employment for SIC category 1611 located in each county. Employment data are obtained from Bureau of Census County Business Patterns.[22]

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82. Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products. EPA-450/2-78-029 (NTIS PB290580), U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

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APPENDIX A

EMISSION FACTOR LISTING

TABLE A-1. 1985 NAPAP AREA SOURCE CATEGORY EMISSION FACTOR UNITS OF MEASUREMENT

SCC	Category Description	Units
001	Residential Fuel - Anthracite Coal	lb/ton
002	Residential Fuel - Bituminous Coal	lb/ton
003	Residential Fuel - Distillate Oil	lb/10^3 gal
004	Residential Fuel - Residual Oil	lb/10^3 gal
005	Residential Fuel - Natural Gas	lb/10^6 ft^3
006	Residential Fuel - Wood	lb/ton
007	Commercial/Institutional Fuel - Anthracite Coal	lb/ton
008	Commercial/Institutional Fuel - Bituminous Coal	lb/ton
009	Commercial/Institutional Fuel - Distillate Oil	lb/10^3 gal
010	Commercial/Institutional Fuel - Residual Oil	lb/10^3 gal
011	Commercial/Institutional Fuel - Natural Gas	lb/10^6 ft^3
012	Commercial/Institutional Fuel - Wood	lb/ton
013	Industrial Fuel - Anthracite Coal	lb/ton
014	Industrial Fuel - Bituminous Coal	lb/ton
015	Industrial Fuel - Coke	lb/ton
016	Industrial Fuel - Distillate Oil	lb/10^3 gal
017	Industrial Fuel - Residual Oil	lb/10^3 gal
018	Industrial Fuel - Natural Gas	lb/10^6 ft^3
019	Industrial Fuel - Wood	lb/ton
020	Industrial Fuel - Process Gas	lb/10^6 ft^3
021	On-Site Incineration - Residential	lb/ton
022	On-Site Incineration - Industrial	lb/ton
023	On-Site Incineration - Commercial/Institutional	lb/ton
024	Open Burning - Residential	lb/ton
025	Open Burning - Industrial	lb/ton
026	Open Burning - Commercial/Residential	lb/ton
027	Light Duty Gasoline Vehicles - Limited Access Roads	g/mi
028	Light Duty Gasoline Vehicles - Rural Roads	g/mi
029	Light Duty Gasoline Vehicles - Suburban Roads	g/mi
030	Light Duty Gasoline Vehicles - Urban Roads	g/mi
031	Light Duty Truck Gasoline Vehicles - Limited Access Roads	g/mi
032	Light Duty Truck Gasoline Vehicles - Rural Roads	g/mi
033	Light Duty Truck Gasoline Vehicles - Suburban Roads	g/mi
034	Light Duty Truck Gasoline Vehicles - Urban Roads	g/mi
035	Heavy Duty Gasoline Vehicles - Limited Access Roads	g/mi
036	Heavy Duty Gasoline Vehicles - Rural Roads	g/mi
037	Heavy Duty Gasoline Vehicles - Suburan Roads	g/mi
038	Heavy Duty Gasoline Vehicles - Urban Roads	g/mi
039	Off-Highway Gasoline Vehicles	lb/10^3 gal
040	Heavy Duty Diesel Vehicles - Limited Access Roads	g/mi

(continued)

TABLE A-1 (continued)

SCC	Category Description	Units
041	Heavy Duty Diesel Vehicles - Rural Roads	g/mi
042	Heavy Duty Diesel Vehicles - Suburban Roads	g/mi
043	Heavy Duty Diesel Vehicles - Urban Roads	g/mi
044	Off-Highway Diesel Vehicles	lb/10^3 gal
045	Railroad Locomotives	lb/10^3 gal
046	Aircraft LTOs - Military	lb/LTO
047	Aircraft LTOs - Civil	lb/LTO
048	Aircraft LTOs - Commercial	lb/LTO
049	Vessels - Coal	lb/ton
050	Vessels - Diesel Oil	lb/10^3 gal
051	Vessels - Residual Oil	lb/10^3 gal
052	Vessels - Gasoline	lb/10^3 gal
053	Solvents Purchased*	lb/ton
054	Gasoline Marketed	lb/10^3 gal
055	Unpaved Road Travel	lb/vehicle mile
056	Unpaved Airstrip LTOs	lb/LTO (no emission factor)
057	Construction	1.2 tons/acre construction
058	Miscellaneous Wind Erosion	no emission factor
059	Land Tilling (Cultivation)	no emission factor
060	Forest Wild Fires	**lb/ton burned
061	Managed Burning - Prescribed	**lb/ton burned
062	Agricultural Field Burning	**lb/ton
063	Frost Control - Orchard Heaters	lb/days fired
064	Structural Fires	lb/structure fire
071	Beef Cattle Manure Field Application	lb/animal
072	Dairy Cattle Manure Field Application	lb/animal
073	Hog and Pig Manure Field Application	lb/animal
074	Broiler Chicken Manure Field Application	lb/animal
075	Other Chicken Manure Field Application	lb/animal
076	Anhydrous Ammonia Fertilizer Application	lb/ton
077	Beef Cattle Feed Lots	lb/day/100 head
078	Degreasing	lb/ton used
079	Drycleaning	lb/ton used
080	Graphic Arts (Printing)	lb/ton used
081	Rubber and Plastics Manufacturing	lb/ton used
082	Architectural Coating	lb/ton used

(continued)

*This category is brokendown into NAPAP categories 078 through 095.
**State-specific loading factor tons/acre burned) must be included in calculation.

TABLE A-1 (continued)

SCC	Category Description	Units
083	Auto Body Repair	lb/ton used
084	Motor Vehicle Manufacturing	lb/ton used
085	Paper Coating	lb/ton used
086	Fabricated Metals	lb/ton used
087	Machinery Manufacturing	lb/ton used
088	Furniture Manufacturing	lb/ton used
089	Flat Wood Products	lb/ton used
090	Other Transportation Equipment Manufacturing	lb/ton used
091	Electrical Equipment Manufacturing	lb/ton used
092	Ship Building and Repairing	lb/ton used
093	Miscellaneous Industrial Manufacturing	lb/ton used
094	Miscellaneous Industrial Solvent Use	lb/ton used
095	Miscellaneous Nonindustrial Solvent Use	lb/ton used
096	Minor Utility Sources - Coal	lb/ton
097	Minor Utility Sources - Oil	lb/10^3 gal
098	Minor Utility Sources - Gas	lb/10^6ft^3
099	Minor Point Sources	lb/ton
100	Publicly-Owned Treatment Works (POTWs)	ton/10^3 gal
101	Cutback Asphalt Paving Operation	lb/ton asphalt
102	Fugitive Emissions From Synthetic Organic Chemical Manufacturing	no emission factor
103	Bulk Terminal and Bulk Plants	no emission factor
104	Fugitive Emissions From Petroleum Refinery Operations	no emission factor
105	Process Emissions From Bakeries	no emission factor
106	Process Emissions From Pharmaceutical Manufacturing	no emission factor
107	Process Emission From Synthetic-Fibers Manufacturing	no emission factor
108	Crude Oil and Natural Gas Production Fields	no emission factor
109	Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs)	no emission factor

TABLE A-2. 1985 NEDS AREA SOURCE EMISSION FACTORS

SOURCE CATEGORY	TSP	SOX	NOX	VOC	CO
01	10.000	39.000	3.000	10.000	90.000
02	15.000	31.000	3.000	10.000	90.000
03	2.500	143.600	10.000	0.700	5.000
04	16.900	157.000	10.000	0.700	5.000
05	3.000	0.600	100.000	5.300	20.000
06	39.298	0.400	2.916	85.718	242.630
07	0.718	37.000	9.800	0.070	0.600
08	0.624	36.200	12.100	0.550	7.200
09	2.000	144.000	20.000	0.300	5.000
10	18.000	158.600	55.000	1.100	5.000
11	3.000	0.600	100.000	5.300	20.000
12	8.000	0.150	0.600	1.400	4.000
13	0.251	39.000	13.600	0.070	0.600
14	0.328	39.000	19.400	0.070	2.500
15	15.200	38.000	10.000	0.200	5.000
16	2.880	143.600	32.500	1.100	7.700
17	19.200	158.600	55.000	0.300	5.000
18	3.000	0.600	797.465	19.292	119.969
19	2.390	143.600	2.400	1.400	4.000
20	60.000	250.000	280.000	6.000	7.000
21	32.000	0.500	1.000	90.000	270.000
22	12.500	2.500	2.500	11.300	16.800
23	7.600	2.400	3.600	4.400	10.400
24	21.500	0.800	5.500	29.000	92.000
25	16.300	0.700	5.500	20.400	99.600
26	16.000	1.000	6.000	30.000	85.000
27	1.300	0.130	2.570	1.950	8.500
28	1.201	0.130	2.280	2.000	10.520
29	4.000	0.130	3.520	3.220	28.810
30	4.881	0.130	2.000	3.330	27.520
31	1.369	0.100	4.410	3.610	15.610
32	1.324	0.180	3.890	3.880	18.580
33	4.069	0.180	4.320	3.990	31.430
34	4.924	0.180	3.370	6.430	50.230
35	2.220	0.360	7.270	9.170	81.120
36	2.220	0.360	6.790	9.400	71.950
37	4.920	0.360	11.740	9.980	152.260
38	5.820	0.360	5.540	12.920	142.630
39	17.452	5.188	125.621	405.001	3591.713
40	4.330	2.800	24.830	2.080	6.260
41	4.330	2.800	19.739	2.330	6.070
42	7.030	2.800	22.620	2.710	7.590
43	7.930	2.800	20.830	4.570	12.750
44	41.262	31.102	374.165	60.033	113.874
45	25.000	57.000	370.000	89.860	130.000
46	19.026	1.213	9.480	22.070	44.610
47	0.000	0.055	0.441	1.235	22.937
48	0.841	1.971	18.350	13.354	50.107
49	60.000	62.000	3.000	10.000	90.000
50	24.000	30.000	224.000	56.000	78.400
51	19.300	254.400	41.800	2.500	1.400
52	0.000	6.393	35.935	789.462	2814.043
53	0.000	0.000	0.000	2000.000	0.000
54	0.000	0.000	0.000	19.000	0.000
55	0.000	0.000	0.000	0.000	0.000
56	0.000	0.000	0.000	0.000	0.000
57	0.000	0.000	0.000	0.000	0.000
58	0.000	0.000	0.000	0.000	0.000
59	0.000	0.000	0.000	0.000	0.000
60	17.000	0.150	4.000	19.200	140.000
61	20.000	0.150	4.000	14.300	112.000
62	14.100	0.000	2.000	13.000	93.700
63	0.200	0.100	0.000	43.000	22.000
64	143.000	0.000	13.500	107.000	582.000

APPENDIX B

NATIONAL EMISSIONS DATA SYSTEM

FUEL CONSUMPTION ALLOCATION PROCEDURES

NEDS Area Source Fuel Consumption Allocation Methodology

The National Air Data Branch (NADB) calculates area source emissions by executing a series of computer programs within the National Emissions Data System (NEDS). The methodology by which emissions for most of the traditional area source categories are calculated is known as the Area Source Fuel Consumption Allocation System (AFCA).

AFCA calculates county level emissions for many Stationary Sources, Mobile Sources, and Miscellaneous Sources using the series of programs shown in Figure B-1. The programs can be broken down into modules which execute the following: 1) generation of the activity level inputs, 2) spatial allocation of the activity level data to the county level, and 3) calculation of emissions and generation of the area source user file update. In general, activity level input data are extracted from references and used to update the AFCA-MASTER file. The AFCA-MASTER file (NEDS-AFC-MST) contains nearly all data inputs required for computation of fuel consumption and county allocation procedures including statistics on population, housing, car registrations, fuel consumption by various sectors, climatological data, point source summary data and employment. Fuel consumption and allocation are performed on these data by the NE099 program which calculates and allocates national and State fuel consumption to the county level using source-specific algorithms. The output from this program is used to update the area source user file and/or emission factor file, and in the process generates emissions. All 1985 NEDS emissions data bases, required input files, and extraction/calculation programs for AFCA resided on the Sperry UNIVAC system at the National Computer Center located in Research Triangle Park, NC until September 1988. For current location of the files contact NADB.

The first section of this appendix contains a brief description of each of the above modules including module inputs, programs, modification procedures, and final outputs. This section is followed by documentation excerpted from AEROS for each of the programs mentioned in the module descriptions. Abstracts and system charts for each program are arranged in numerical order for convenience. More complete information on specific programs is available from the Source Code Library at NADB.

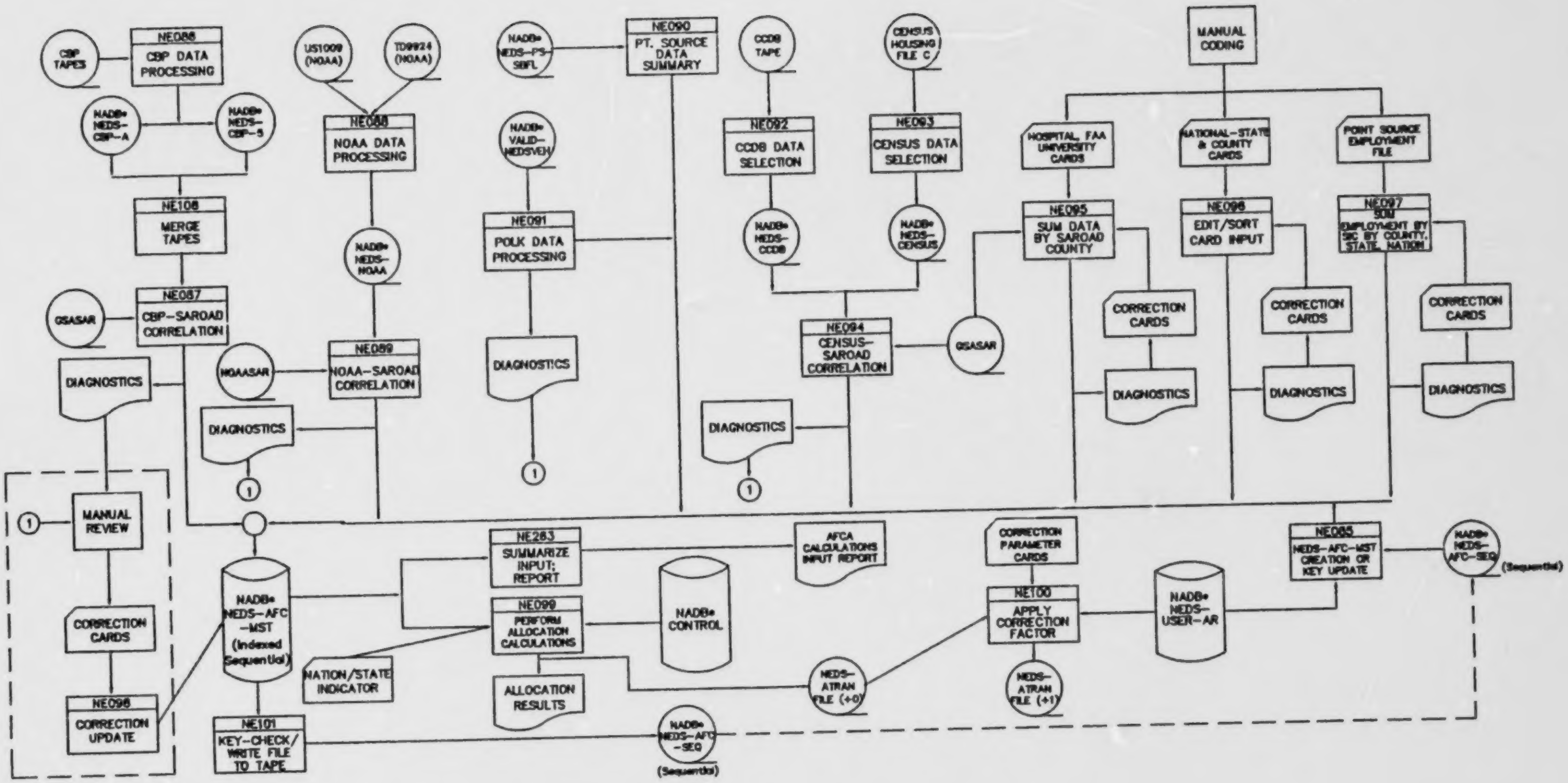

CBP TAPES
NE086
CBP DATA PROCESSING
NADB• NEDS-CBP-A
NADB• NEDS-CBP-5
NE108
MERGE TAPES
GSASAR
NE087
CBP-SAROAD CORRELATION
DIAGNOSTICS
US1009 (NOAA)
TD9924 (NOAA)
NE088
NOAA DATA PROCESSING
NADB• NEDS-NOAA
NOAASAR
NE089
NOAA-SAROAD CORRELATION
DIAGNOSTICS
1
NADB• NEDS-PS-SBFL
NE090
PT. SOURCE DATA SUMMARY
NADB• VALID-NEDSVEH
NE091
POLK DATA PROCESSING
DIAGNOSTICS
1
CCDB TAPE
NE092
CCDB DATA SELECTION
NADB• NEDS-CCDB
CENSUS HOUSING FILE C
NE093
CENSUS DATA SELECTION
NADB• NEDS-CENSUS
NE094
CENSUS-SAROAD CORRELATION
GSASAR
DIAGNOSTICS
1
MANUAL CODING
HOSPITAL, FAA UNIVERSITY CARDS
NE095
SUM DATA BY SAROAD COUNTY
CORRECTION CARDS
DIAGNOSTICS
NATIONAL-STATE & COUNTY CARDS
NE096
EDIT/SORT CARD INPUT
CORRECTION CARDS
DIAGNOSTICS
POINT SOURCE EMPLOYMENT FILE
NE097
SUM
EMPLOYMENT BY SIC BY COUNTY, STATE, NATION
CORRECTION CARDS
DIAGNOSTICS
1
MANUAL REVIEW
CORRECTION CARDS
NE098
CORRECTION UPDATE
NADB• NEDS-AFC -MST (Indexed Sequential)
NE101
KEY-CHECK/ WRITE FILE TO TAPE
NATION/STATE INDICATOR
NE283
SUMMARIZE INPUT; REPORT
NE099
PERFORM ALLOCATION CALCULATIONS
ALLOCATION RESULTS
NADB• CONTROL
NADB• NEDS-AFC -SEQ
(Sequential)
AFCA CALCULATIONS INPUT REPORT
CORRECTION PARAMETER CARDS
NE100
APPLY CORRECTION FACTOR
NEDS-ATRAN FILE (+0)
NEDS-ATRAN FILE (+1)
NADB• NEDS-USER-AR
NE085
NEDS-AFC-MST CREATION OR KEY UPDATE
NADB• NEDS-AFC-SEQ
(Sequential)

Figure B-1. NEDS Area Fuel Consumption Allocation (AFCA) System Flowchart.

GENERATION OF ACTIVITY LEVEL INPUTS

The purpose of this module is to assemble all appropriate statistics needed by the allocation module into one file called the AFCA-MASTER file (NEDS-AFC-MST). This involves the use of programs which convert national, State, and county statistics obtained from published governmental and private documents on system data files into the appropriate input units and data formats required for execution of the allocation program. Each program extracts or adapts data from either specific reference data tape(s) or manually-coded cards. In the final step of most programs, the extracted data are used to update data in the AFCA-MASTER file (NEDS-AFC-MST) directly.

A description of each data extraction program is presented according to its position in Figure B-1. These include programs which extract data elements from data tapes of County Business Patterns, NOAA data, Polk Vehicle Registration data, County and City Data Book, and Census of Housing data. Some programs also extract data from NEDS point source files and manually-coded cards.

County Business Patterns (CBP) Data

NE086 is the first of two programs which annually processes Census Bureau data from the County Business Patterns (CBP) files by selecting county, State, and national employment data for specific SICs. NE086 outputs one tape for each of the 9 census regions, which are then merged into one tape by NE108. NE087 processes the merged CBP data by cross-referencing county data with SAROAD county codes and summing employment by SAROAD county. The resulting data are used to update the AFCA-MASTER file (NEDS-AFC-MST).

NOAA Climatological Data

NE088 selects specific weather station climatological data from two National Oceanic and Atmospheric Administration (NOAA) data tapes. The processing includes the summation of monthly records, conversion of units, and the assignment of record completeness codes. NE089 determines and assigns a degree-days, number of "warm" months, annual freeze-free days, and annual snowfall.

Polk Vehicle Registration Data

NE082 is a 3-part program which manipulates R. L. Polk vehicle registration tape data to create an indexed mass storage file for use by the mobile source emission factor program (NE111). NE082A merges up to 8 Polk data tapes to form one tape. The program can be executed a second time to merge the tape from a previous NE082A run with up to 7 more Polk tapes. Data extracted from the Polk tapes include vehicle type, model year, and vehicle counts by Polk geographical code. The tape from NE082A is used as input to the NE082B program which combines and sorts the records by county and creates the Valid Vehicle file (VALID-VEH) which contains one record for each county. Each county record contains the number of gasoline-powered vehicles and the number of trucks registered for each model year for six truck classes. NE082C reads the output tape from the NE082B and creates a mass storage copy of the VALID-VEH file indexed by NEDS county code. NE091 then processes the vehicle registration counts and applies registration totals to the AFCA-MASTER file (NEDS-AFC-MST).

Point Source Data Summary File

NE090 processes a tape subfile of the NEDS point source data base (NE001) containing only point records with Source Classification Codes (SCCs) starting with 102, 103, 202, 203 or 390. NE090 examines the operating rate field of each point record to determine its annual fuel consumption. Statewide point source fuel consumption totals by point source category (industrial or commercial) and fuel type are then calculated and used to update AFCA-MASTER county and State files.

Census Data

NE092 selects and processes Census Bureau data from the County and City Data Book (CCDB) tape file. This includes statistics such as the number of housing units, school enrollment, population, percentage of urban population, and population density. NE093 selects data from the most recent decennial

Census of Housing tape (File C) including statistics such as population and the number of housing units using fuels for specific tasks (space-heating, cooking fuel, etc.). NE094 combines the output from NE092 and NE093, and assigns the appropriate SAROAD county code to each record using GSASAR. County totals are used to update the AFCA-MASTER file (NEDS-AFC-MST).

Hospital, University, and FAA Data

NE095 processes card-image data for the number of hospital beds and hospital employment, university enrollment, and operations for commercial, general, and military aircraft. The program cross-references and assigns the appropriate SAROAD county code to each record using the GSASAR file. Data summed at the county level are used to update the AFCA-MASTER file (NEDS-AFC-MST).

Selected National, State and County Data

NE096 processes card-image data extracted from government and private publications and applies them to the AFCA-MASTER file national, State and County Record. The input file contains data on population, geography, and fuel use, highway consumption of gasoline on the State level, and civil aircraft registration data by county. The data are edited and sorted and then used to update the AFCA-MASTER file (NEDS-AFC-MST).

Point Source Employment Files

NE097 sorts card-image point source employment data and generates county and national totals for Standard Industrial Classification codes (SICs) 20 through 39 and for SICs involved in solvent use. The data are used to update the national and county records of the AFCA-MASTER file (NEDS-AFC-MST).

After each update program has been executed, a mechanism is available for the modification and addition of AFCA-MASTER records. NE098 processes card-image data to correct input errors identified by diagnostics reports generated by NE087, NE089, NE091, and NE094. It also enables NADB to correct erroneous data and provide its own estimates for certain data items. Execution of this program updates the AFCA-MASTER file (NEDS-AFC-MST) and creates the final version of statistics needed for allocation calculations.

COUNTY ALLOCATION OF FUEL CONSUMPTION

NE099 computes the county fuel allocation for area sources referenced in the main document including major categories in Stationary Sources, Mobile Sources, and Miscellaneous Area Sources categories. NE099 requires the updated AFCA-MASTER file (NEDS-AFC-MST), a NADB control file, and an indicator file as inputs to a program which allocates fuel consumption statistics to each county. The NADB*CONTROL file contains variables updated by NADB periodically for which the values remain relatively stable. The indicator file allows the user to specify counties for which NE099 are to be executed. Allocation is accomplished using algorithms which estimate consumption based on surrogate variables identifed by prior research and regression analysis. County consumption estimates for specific area source categories are calculated in one of four execution passes. Algorithms for each category listed below are detailed in the NE099 documentation.

1. Stationary Sources
    - Residential Anthracite and Bituminous Coal Consumption
    - Residential Distillate Oil Consumption
    - Commercial Natural Gas Consumption
    - Commercial Anthracite and Bituminous Coal Consumption
    - Commercial Residual and Distillate Oil Consumption
    - Industrial Distillate Oil, Residual Oil, Natural Gas, and Bituminous Coal Consumption
    - Bituminous Sulfur and Ash Content

2. Mobile Sources
    - Highway sources
        - Light-duty Vehicle Gasoline Consumption (using reported VMT)
        - Light-duty Vehicle Gasoline Consumption (with no VMT)
        - Heavy-duty Vehicle Gasoline and Diesel Consumption
    - Off-highway Sources Consumption
    - Railroad Diesel Consumption
    - LTOs for Military, Civilian and Commercial Aircraft
    - Marine Vessel Gasoline Consumption

3. Miscellaneous Area Sources
    - Organic Solvent Consumption
    - Retail Gasoline Sales

The final output tape (NEDS-ATRAN) contains final computed county estimates consisting of four card-image records per SAROAD county.

A formatted report is also generated. NE100 is then used to update area source categories not calculated by NE099 or to make adjustment to the data calculated by NE099. Activity level estimates for these area sources are modified by State ratio update factors by NE100. The output is an updated version of NEDS-ATRAN shown as NEDS-ATRAN(+1) in Figure B-1.

EMISSIONS CALCULATIONS AND AREA SOURCE USER FILE UPDATE

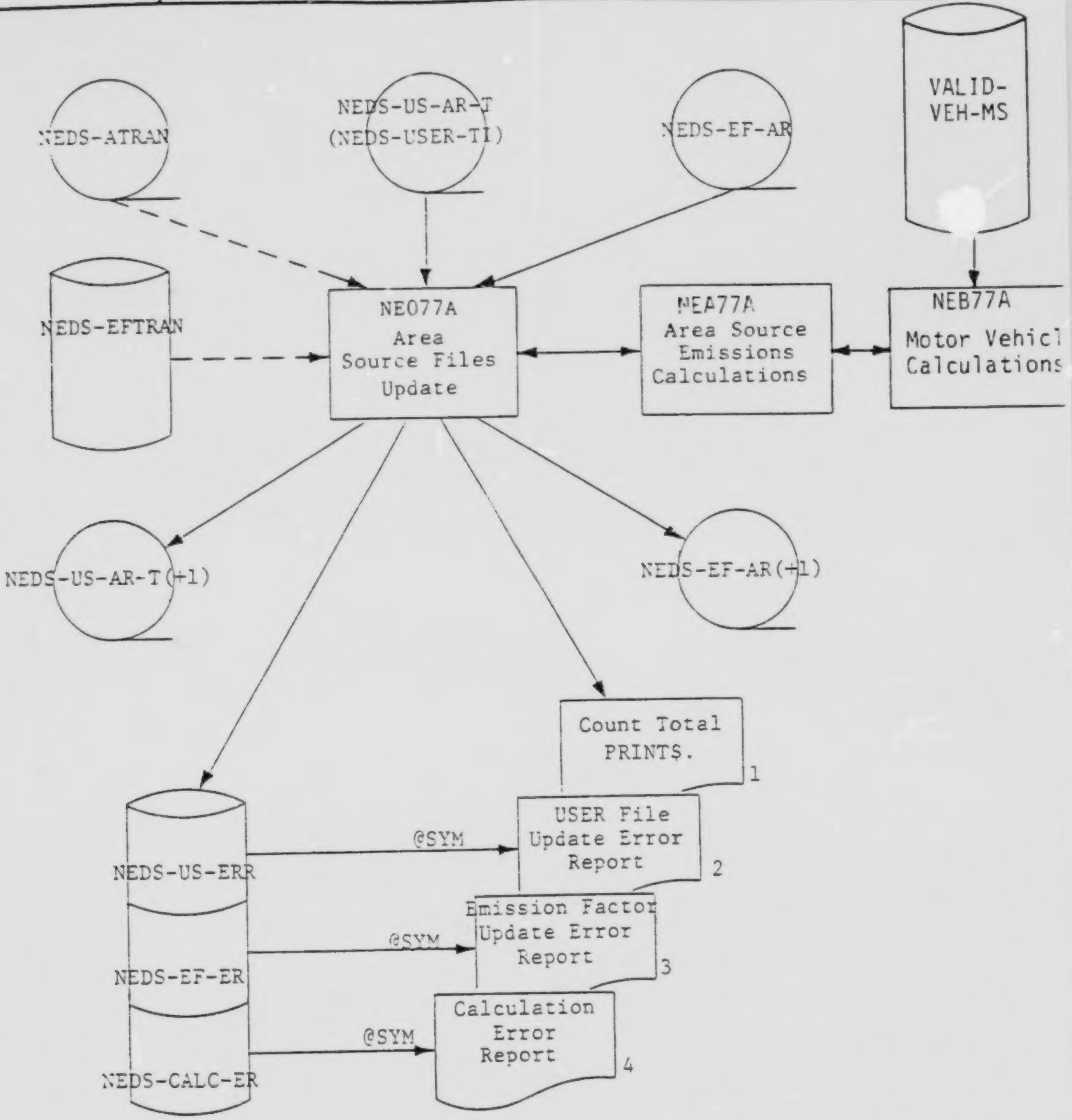
NE077A updates the area source user file (NEDS-US-AR-T) and the emission factor file (NEDS-EF-AR) with the results from NE099 and NE100 (NEDS-ATRAN(+1) file), and mobile source emission factor data from NE111, and in the process generates emissions. NE077A calls subprograms that calculate emissions. NEA77A calculates emissions for categories except highway vehicles. NEB77A calculates highway vehicle emissions by computing vehicle miles of travel (VMT) by vehicle type and road speed category to go with the mobile source emission factors from NE111. Finally, NE077B copies the area source user tape file and creates an indexed-sequential disk file (NEDS-USER-AR). This completes the area source update process.

1. Component Name:

NE077A, Area Source Files Update.

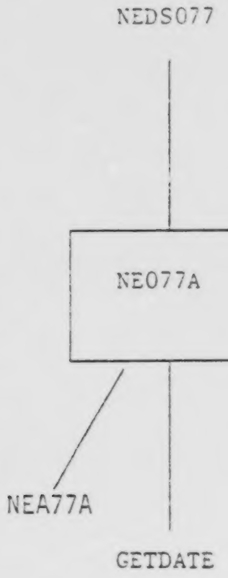
2. Run Description:

This program updates the area source user file (NEDS-US-AR-T) and/or the area source emission factor file (NEDS-EF-AR).


NEDS-ATRAN
NEDS-US-AR-T
(NEDS-USER-TI)
NEDS-EF-AR
VALID-
VEH-MS
NEDS-EFTRAN
NE077A
Area
Source Files
Update
NEA77A
Area Source
Emissions
Calculations
NEB77A
Motor Vehicl
Calculations
NEDS-US-AR-T(+1)
NEDS-EF-AR(+1)
Count Total
PRINTS.
1
NEDS-US-ERR
@SYM
USER File
Update Error
Report
2
NEDS-EF-ER
@SYM
Emission Factor
Update Error
Report
3
NEDS-CALC-ER
@SYM
Calculation
Error
Report
4

System Flowchart: NE077A

Note: 1. Internal filenames are shown in parentheses except where they are the same as the external name.


NEDS077
NE077A
NEA77A
GETDATE

Hierarchy Chart: NE077A

AEROS SOFTWARE	COMPONENT NAME: NEA77A	SECTION 1 PAGE 1
DOCUMENTATION	SECTION: Abstract	DATE 15 November 1978

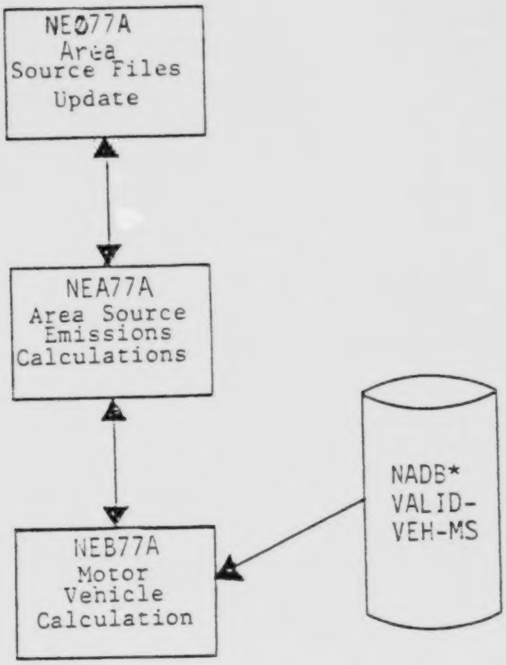
1. Component Name:

NEA77A, Area Source Emissions Calculations.

2. Run Description:

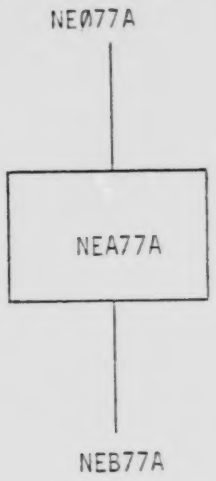
The function of the Area Source Emissions Calculations subprogram is to calculate emissions for any source category/pollutants that need computer calculations on the area source record passed to the subprogram. To accomplish this, the subprogram is passed national, state, and county area source emission factor records and an area source user record by the calling program in a common storage area. The calculate-emission flags in the area source user record determine which source categories need to be recalculated.

AEROS SOFTWARE	COMPONENT NAME: NEA77A	SECTION 2 PAGE 1
DOCUMENTATION	SECTION: System Charts	DATE March 25, 1981


NE077A
Area
Source Files
Update
NEA77A
Area Source
Emissions
Calculations
NEB77A
Motor
Vehicle
Calculation
NADB*
VALID-
VEH-MS

System Flowchart: NEA77A

AEROS SOFTWARE	COMPONENT NAME: NEA77A	SECTION 2 PAGE 2
DOCUMENTATION	SECTION: System Charts	DATE 15 November 1978


NE077A
NEA77A
NEB77A

Hierarchy Chart: NEA77A

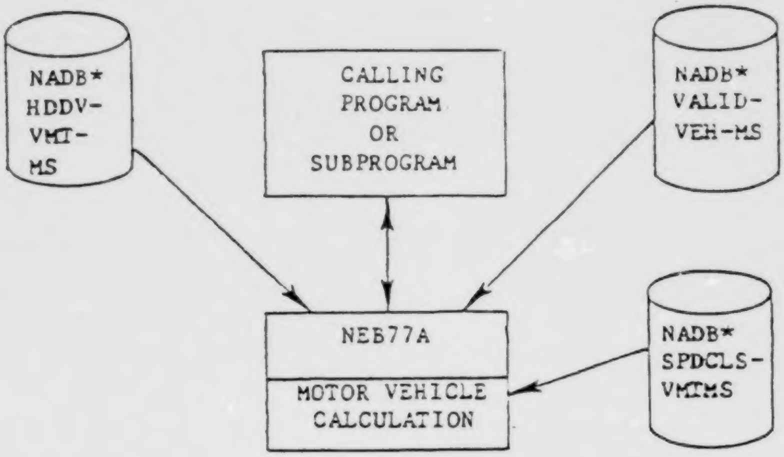
Descriptive Name of Component: Motor Vehicle Calculation NEB77A

Run Description:

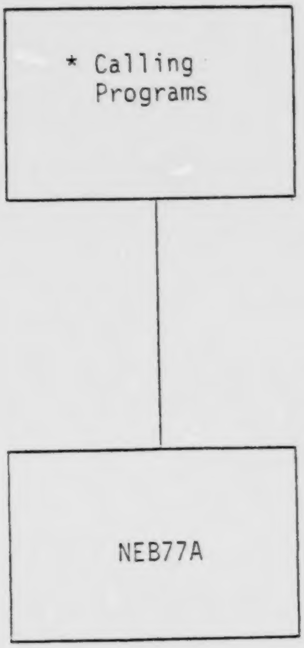
This subprogram is called by the calculation subprogram NEA77A and the area source listing program NE260 to compute the miles traveled by road/vehicle type. It uses the activity level data in the area source user record, the county vehicle registrations from the file VALID-VEH-MS, county level estimates of long and short range VMT accrued by HDDV from HDDV-VMT-MS, and the county level fractional distributions of VMT by speed class from SPDCLS-VMTMS. The subprogram returns a status switch indicating whether the data were calculated or measured and an array containing the data.

AEROS SOFTWARE	COMPONENT NAME NEB77A	SECTION 2 PAGE 1
DOCUMENTATION	SECTION: SYSTEM CHARTS	DATE August 15, 1986

SYSTEM FLOWCHART


NADB*
HDDV-
VMT-
MS
CALLING
PROGRAM
OR
SUBPROGRAM
NADB*
VALID-
VEH-MS
NEB77A
MOTOR VEHICLE
CALCULATION
NADB*
SPDCLS-
VMTMS

Hierarchy Chart


* Calling
Programs
NEB77A

* NE077A, NE260

1. Component Name:

NE077B, Area Source User File Copy

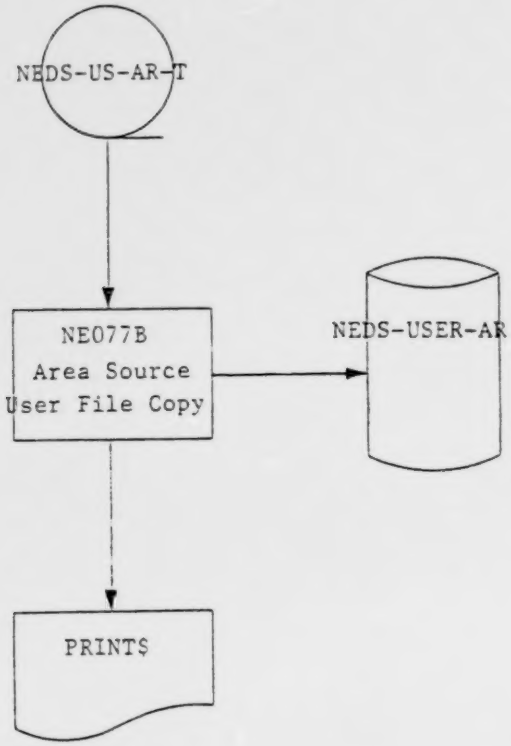
2. Run Description:

This program, NE077B, copies records from the sequential tape file NEDS-US-AR-T and creates the indexed-sequential disk file NEDS-USER-AR. The tape file, NEDS-US-AR-T, is created by the NEDS AREA SOURCE update program, NE077A.

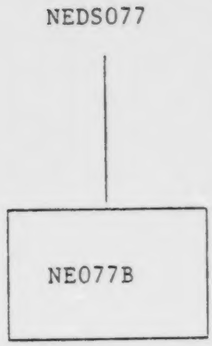
The disk file is used by NEDS Area Source Report programs for data retrieval. NE077B, generates a report which contains:

1) Beginning time and date
2) Ending time and date and
3) Number of records copied.

AEROS SOFTWARE DOCUMENTATION	**COMPONENT NAME:** NE077B **SECTION:** System Charts	**SECTION** 2 **PAGE** 1 **DATE** 29 November 1978


NEDS-US-AR-T
NE077B
Area Source
User File Copy
NEDS-USER-AR
PRINT$

System Flowchart: NE077B



Hierarchy Chart: NE077B

Section 1: ABSTRACT

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE082A SECTION: ABSTRACT	SECTION 1 PAGE 2 DATE 2/15/81

DESCRIPTIVE NAME OF COMPONENT: MERGE R. L. POLK TAPES

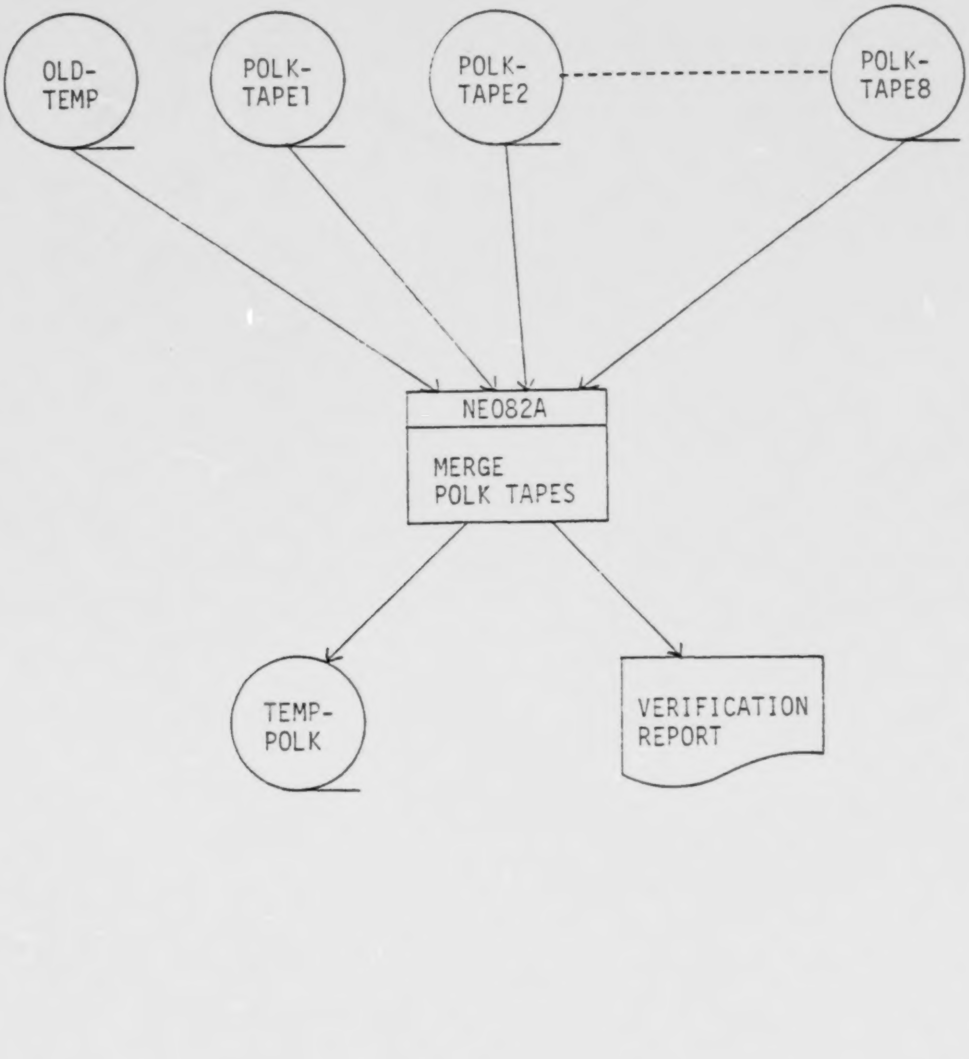
RUN DESCRIPTION:

NE082A is the first program in a system of three programs to create the NADB*VALID-VEH vehicle registration tape from R. L. Polk vehicle registration data tapes. NE082A performs the function of merging all of the Polk tape files to form one ASCII tape file, TEMP-POLK. The program will merge up to eight Polk tapes at one time. If there are more than eight Polk tapes, the program will also merge a TEMP-POLK tape created from a previous run with up to eight more Polk tapes. Each record on the TEMP-POLK tape contains the Polk geographic code, vehicle type, model year and vehicle counts. A verification report is also printed displaying the number of records read for each vehicle type for each county. The TEMP-POLK tape is then used as input to the program NE082B to create NADB*VALID-VEH.

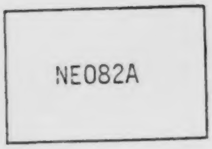
Section 2: SYSTEM CHARTS

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE082A SECTION: SYSTEM CHARTS	SECTION 2 PAGE 2 DATE 2/15/81

SYSTEM FLOWCHART


OLD-TEMP
POLK-TAPE1
POLK-TAPE2
POLK-TAPE8
NE082A
MERGE POLK TAPES
TEMP-POLK
VERIFICATION REPORT

Hierarchy Chart



Section 1: ABSTRACT

DESCRIPTIVE NAME OF COMPONENT: CREATE VALID-VEH TAPE FILE

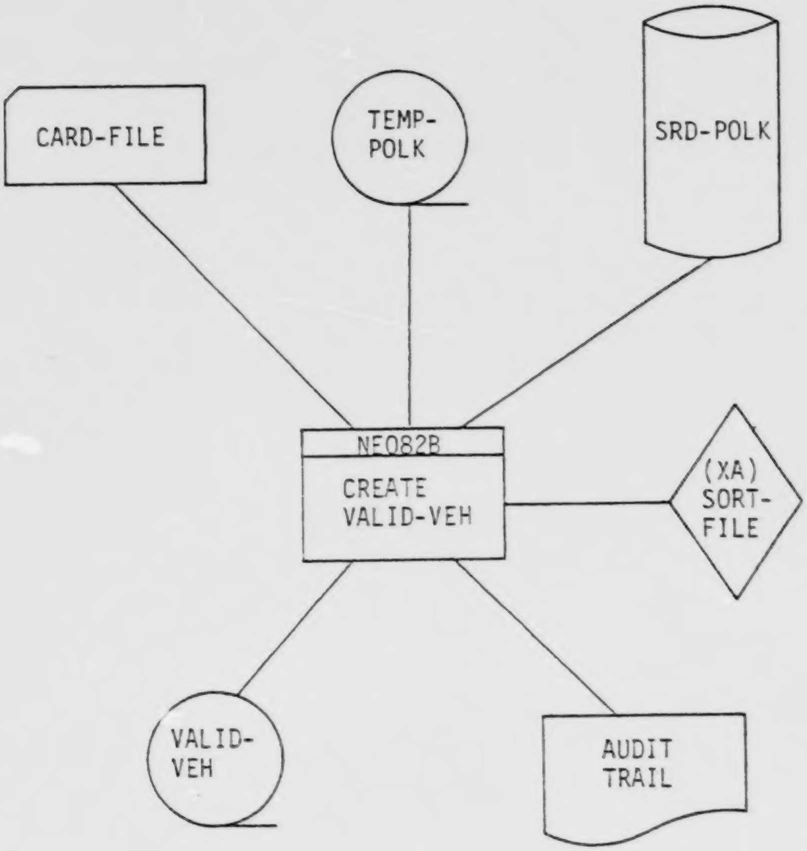
RUN DESCRIPTION:

NE082B is the second in a system of three programs to create the NADB*VALID-VEH vehicle registration tape file from the R. L. Polk vehicle registration tapes received periodically from the Department of Transportation. The program has as input the merged Polk tape, TEMP-POLK created earlier by the program NE082A.

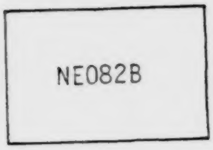
Each TEMP-POLK record contains the Polk geographic code, vehicle, model year and vehicle registration count. These records are combined and summed to create one VALID-VEH record for each county in the nation. The Polk state and county codes are converted to SAROAD state and county codes by accessing the NADB*SRD-POLK cross reference file. Included on each record are the number of gasoline powered vehicles for each model year, the sum of all the gasoline powered passenger vehicles and the number of trucks registered for each model year for six different classes of trucks. The six classes are light duty gasoline (0-6000lbs), light duty gasoline (6001-10,000lbs), heavy duty gasoline (10,001-14,000lbs), heavy duty gasoline (14,001-19,500lbs), heavy duty gasoline (over 19,500lbs) and heavy duty diesel (over 10,000lbs). The record also contains the total counts of trucks in class 1 and class 2 for all model years, the number of light duty diesel passenger vehicles registered for each model year, the number of light duty diesel trucks (0-6000lbs) for each model year and the number of light duty diesel trucks (6001-10,000lbs) for each model year. These records are sorted in ascending order by SAROAD state-county. An audit trail is printed displaying the number of Polk records read and the number of VALID-VEH records written.

Section 2: SYSTEM CHARTS

SYSTEM FLOWCHART


CARD-FILE
TEMP-POLK
SRD-POLK
NE082B
CREATE VALID-VEH
(XA) SORT-FILE
VALID-VEH
AUDIT TRAIL

Hierarchy Chart



Section 1: ABSTRACT

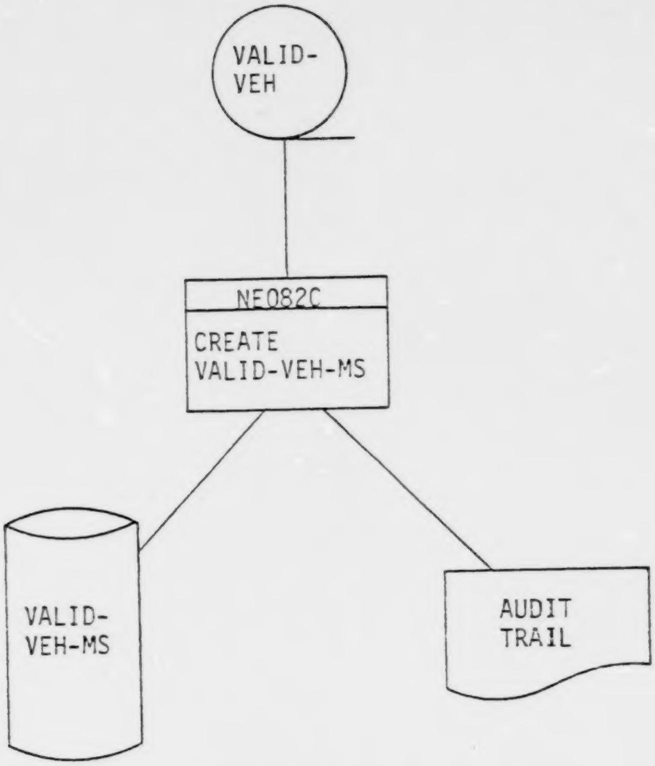
Descriptive Name of Component: CREATE VALID-VEH-MS
MASS STORAGE FILE

Run Description:

NE082C is the third in a system of three programs to create the NADB*VALID-VEH vehicle registration tape file and the NADB*VALID-VEH-MS mass storage version of the tape. The program has as input the VALID-VEH tape file created earlier by the program NE082B. NE082C reads this tape file and creates an index sequential mass storage copy of the file. The key is the state-county code. NADB*VALID-VEH-MS is used as input to the program NEB77A.

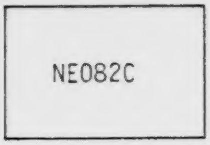
Section 2: SYSTEM CHARTS

SYSTEM FLOWCHART



VALID-VEH
NE082C
CREATE VALID-VEH-MS
VALID-VEH-MS
AUDIT TRAIL

Hierarchy Chart



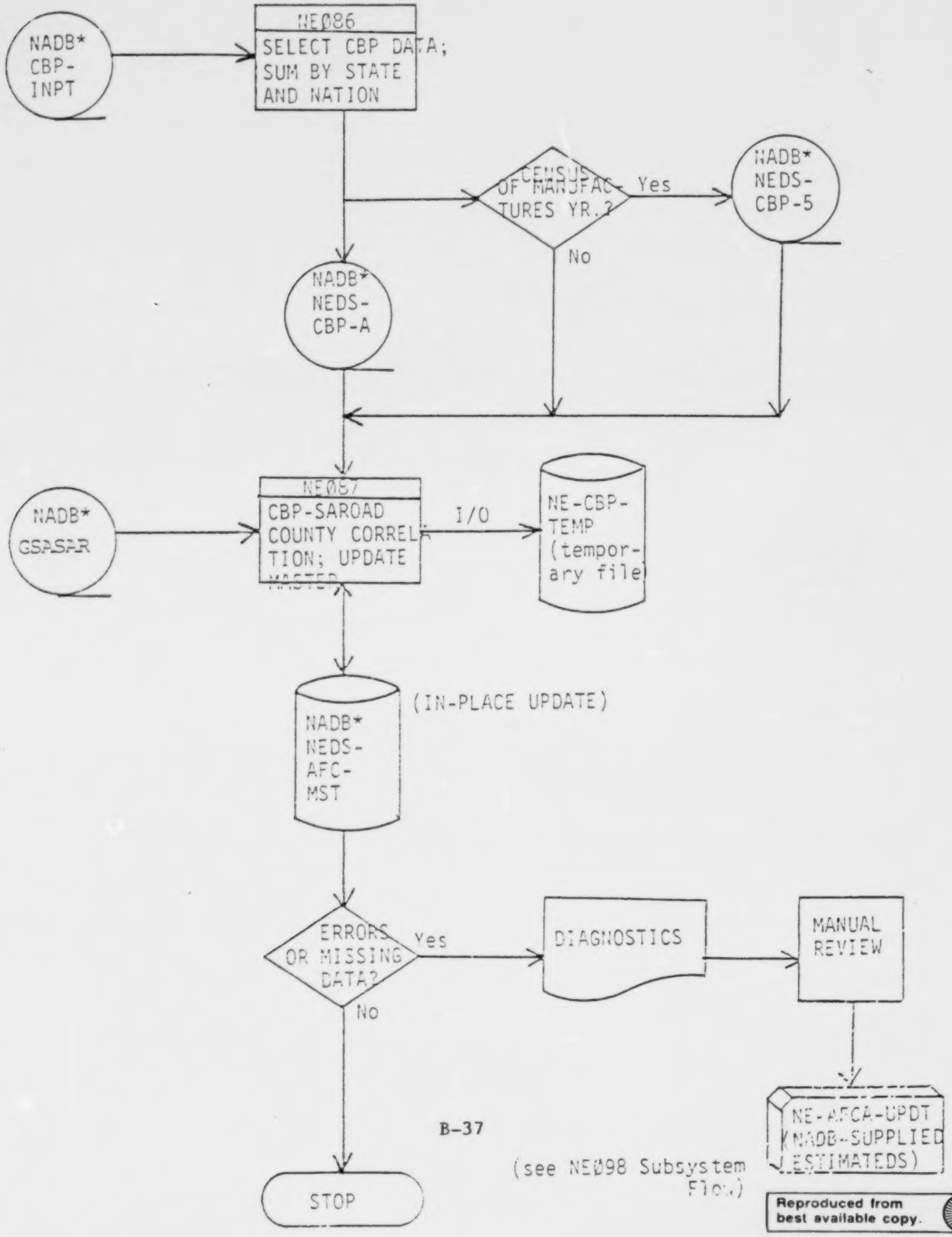
DESCRIPTIVE NAME: CBP Data Selector

RUN DESCRIPTION

NE086 is the first of two programs which process Census Bureau data from the County Business Patterns (CBP) tape files. The program must be run once every year to select current CBP data that is required as input to AFCA calculations.

The tape reels which comprise the most recent County Business Patterns file are input to program NE086. CBP records contain county employment data by SIC (Standard Industrial Classification) code summaries. The following totals are selected or computed from CBP data and written to output tape file NEDS-CBP-A: county employment totals for SIC's 10, 50, 19-39 and commercial and solvent-user SIC's; state employment totals for SIC's 16, 19 and commercial SIC's; and national employment total for SIC's 10, 50, 19, 16 and solvent-user SIC's.

In years when new Census of Manufacturers data is available (quinquennially) the run condition-word is set to cause program NE086 to produce a second output tape file, NEDS-CBP-5. State and national employment totals for SIC's 20-39 are written to file NEDS-CBP-5.

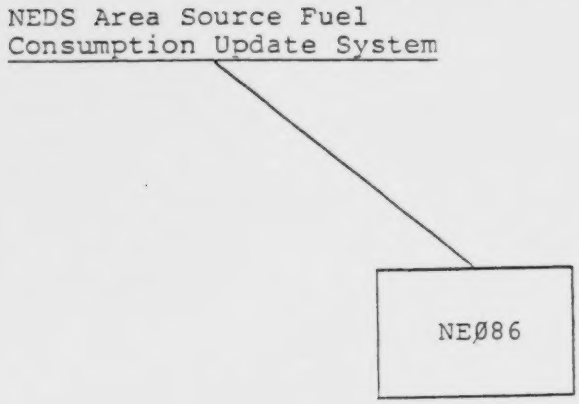


NADB*
CBP-
INPT
NE086
SELECT CBP DATA;
SUM BY STATE
AND NATION
CENSUS
OF MANUFAC-
TURES YR.?
Yes
No
NADB*
NEDS-
CBP-5
NADB*
NEDS-
CBP-A
NADB*
GSASAR
NE087
CBP-SAROAD
COUNTY CORREL-
TION; UPDATE
MASTER
I/O
NE-CBP-
TEMP
(temporary file)
NADB*
NEDS-
AFC-
MST
(IN-PLACE UPDATE)
ERRORS
OR MISSING
DATA?
Yes
No
DIAGNOSTICS
MANUAL
REVIEW
NE-AFCA-UPDT
(NADB-SUPPLIED
ESTIMATEDS)
STOP

(see NE098 Subsystem Flow)

Reproduced from best available copy.

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE086

AEROS SOFTWARE **DOCUMENTATION**	**COMPONENT NAME:** NE087 **SECTION:** AEROS Abstract	**SECTION** 1 **PAGE** 1 **DATE** 9/13/78

DESCRIPTIVE NAME: CBP Data Update of NEDS-AFC-MST

RUN DESCRIPTION

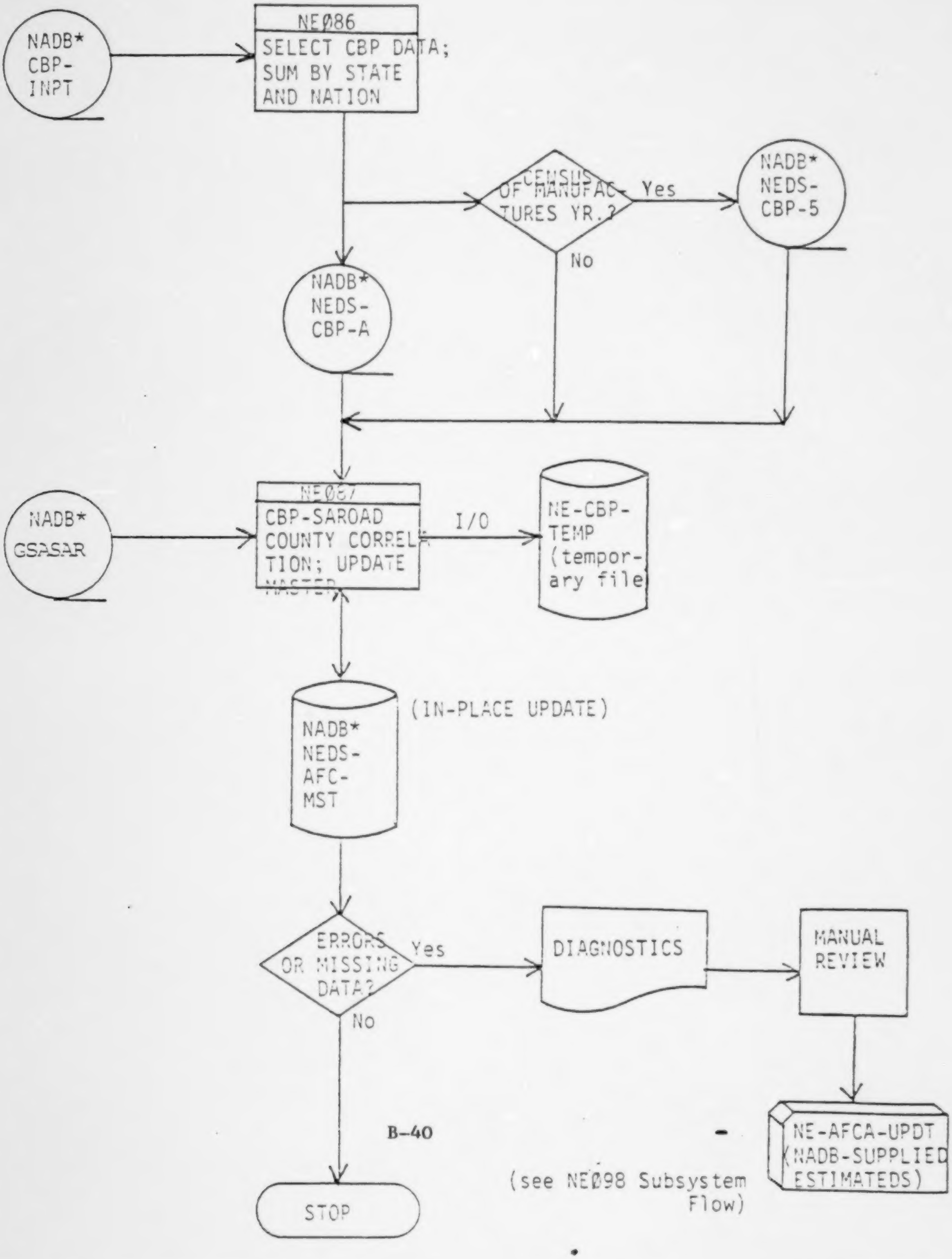
NE087 is the second of two programs which process CBP data for the AFCA system. The program must be run once each year to apply current CBP data to the NEDS-AFC-MST file.

NE087 has up to three input sources. Two tape files are input to every execution of the program: NEDS-CBP-A, which is output by program NE086, and GSASAR which contains a FIPS-SAROAD county code cross-reference. A third tape file is input on a quinquennial basis: NEDS-CBP-5 also output by program NE086.

County totals on file NEDS-CBP-A are matched to SAROAD county codes in file GSASAR. This data is then summed by SAROAD county before being applied, with state and national totals from NEDS-CBP-A and NEDS-CBP-5, as updates to records on NEDS-AFC-MST.

NE087 produces diagnostic messages when: there is no matching SAROAD code for a CBP (FIPS) county total; or a SAROAD county or state code on GSASAR has no matching data in either file NEDS-CBP-A or NEDS-CBP-5.

AEROS SOFTWARE DOCUMENTATION	**COMPONENT NAME:** NE087 **SECTION:** System Charts	**SECTION** 2 **PAGE** 1 **DATE** 9/13/78



NADB* CBP-INPT
NE086
SELECT CBP DATA; SUM BY STATE AND NATION
CENSUS OF MANUFACTURES YR.?
Yes
No
NADB* NEDS-CBP-5
NADB* NEDS-CBP-A
NADB* GSASAR
NE087
CBP-SAROAD COUNTY CORRELATION; UPDATE MASTER
I/O
NE-CBP-TEMP (temporary file
NADB* NEDS-AFC-MST
(IN-PLACE UPDATE)
ERRORS OR MISSING DATA?
Yes
No
DIAGNOSTICS
MANUAL REVIEW
NE-AFCA-UPDT (NADB-SUPPLIED ESTIMATEDS)
(see NE098 Subsystem Flow)
STOP

AEROS SOFTWARE	COMPONENT NAME: NE088	SECTION 1 PAGE 1
DOCUMENTATION	SECTION: AEROS Abstract	DATE September, 1986

DESCRIPTIVE NAME: NOAA Climatological Data Selector

RUN DESCRIPTION

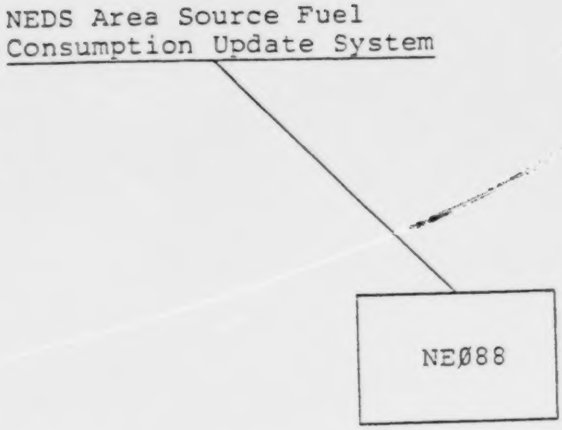
NE088 is the first of two programs which process climatological data required as input to AFCA calculations. The program must be run once each year to select current data from tape files produced annually by the National Oceanographic and Atmospheric Administration.

Two tape files are input to NE088: the US1009 Name Tape and the TD3220 monthly climatological data tape. Type '3' records (station records) are selected from the US1009 file if data availability indicators show that the record is for a weather station that recorded temperature and/or snowfall data. Station records selected from the US1009 tape are matched to records for the same stations on the TD3220 tape. Each station on the TD3220 tape has up to twelve monthly records of climatological data. Selected monthly data items are summed for the year and resulting totals are written to output file NEDS-NOAA. If the station's temperature and precipitation unit identifiers (from the US1009 record) require it, temperatures are converted from Celsius to Fahrenheit and precipitation measures are converted from metric units to hundredths of inches. If data items for a selected weather station are missing from the TD3220 tape, a data completeness code of '1' (50% or less missing) or '2' (more than 50% missing) is assigned to the station record.

NE088's output tape file, NEDS-NOAA, will consist of weather station records with the following data items: NOAA division number, station number, SAROAD state code, station latitude and longitude, annual degree days, number of "warm" months, number of days of year that temperature $\leq 32^0$ F, annual snowfall, and station's data completeness code.

NOTE: Data for Alaska, Hawaii, and the District of Columbia are not on the US1009 or TD3220 tapes.

HIERARCHY CHART


NEDS Area Source Fuel
Consumption Update System
NE088

DESCRIPTIVE NAME: Annual NOAA Data Update

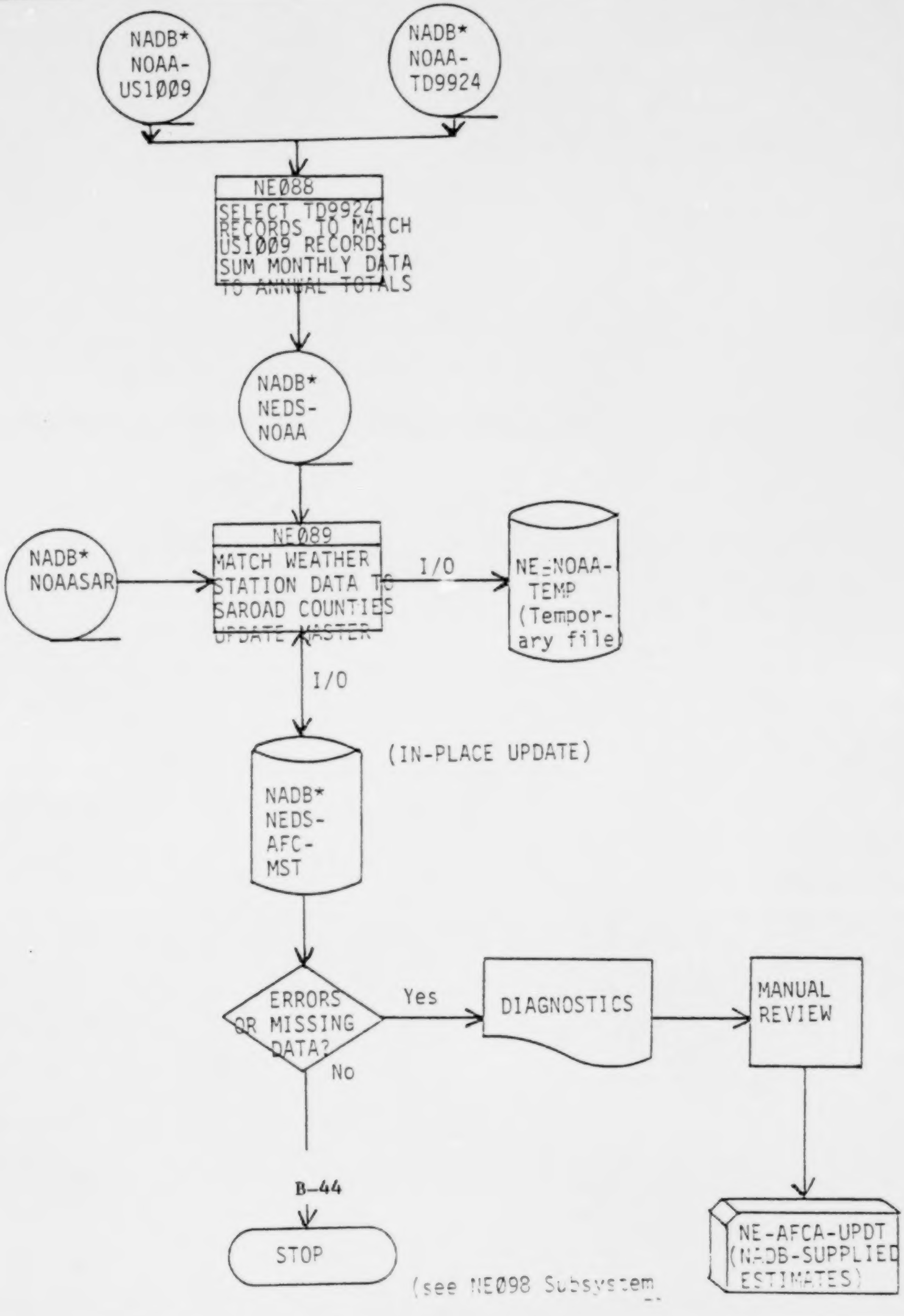
RUN DESCRIPTION

NE089 is the second of two climatological data processing programs in the AFCA system. The program must be run once each year to apply current NOAA data to the NEDS-AFC-MST file.

Two tape files are input to NE089: NEDS-NOAA produced by the NE088 program, and NOAASAR which contains a SAROAD county-NOAA station number cross-reference. The program reads data from file NEDS-NOAA, assigns data to each SAROAD county by using the NOAASAR cross-reference, and updates county records on NEDS-AFC-MST with this data. If a station record on file NEDS-NOAA has a data completeness code of '1' or '2', the program performs a search for replacement data from the nearest weather station using latitude and longitude information from both input files.

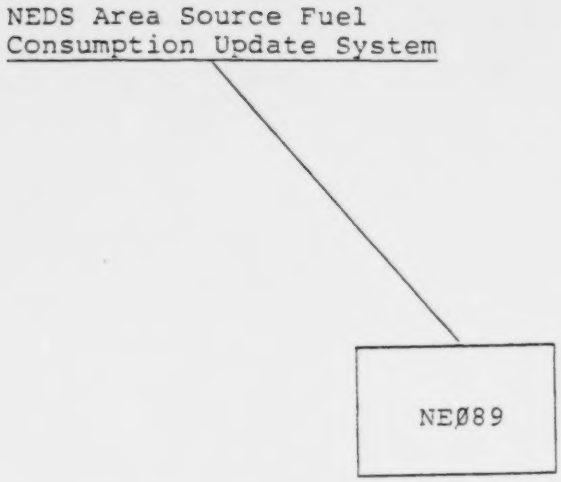
At the completion of program NE089, county records in NEDS-AFC-MST file will be updated with current NOAA data for the following items: annual degree days, number of "warm" months, number of freeze-free days a year, and annual snowfall. The national-level record in NEDS-AFC-MST will contain a total of freeze-free days for all SAROAD counties and a snow-zone snowfall total (total annual snowfall for all SAROAD counties where annual snowfall > 30 inches).

Program NE089 also produces a diagnostic listing of all SAROAD counties for which some NOAA climatological data is unavailable.



NADB*
NOAA-
US1009
NADB*
NOAA-
TD9924
NE088
SELECT TD9924 RECORDS TO MATCH US1009 RECORDS SUM MONTHLY DATA TO ANNUAL TOTALS
NADB*
NEDS-
NOAA
NADB*
NOAASAR
NE089
MATCH WEATHER STATION DATA TO SAROAD COUNTIES UPDATE MASTER
I/O
NE-NOAA-TEMP (Temporary file)
I/O
(IN-PLACE UPDATE)
NADB*
NEDS-
AFC-
MST
ERRORS OR MISSING DATA?
Yes
No
DIAGNOSTICS
MANUAL REVIEW
STOP
NE-AFCA-UPDT (NADB-SUPPLIED ESTIMATES)
(see NE098 Subsystem

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE089

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NEA089 SECTION: Abstract	SECTION 1 PAGE 1 DATE 9/1/78

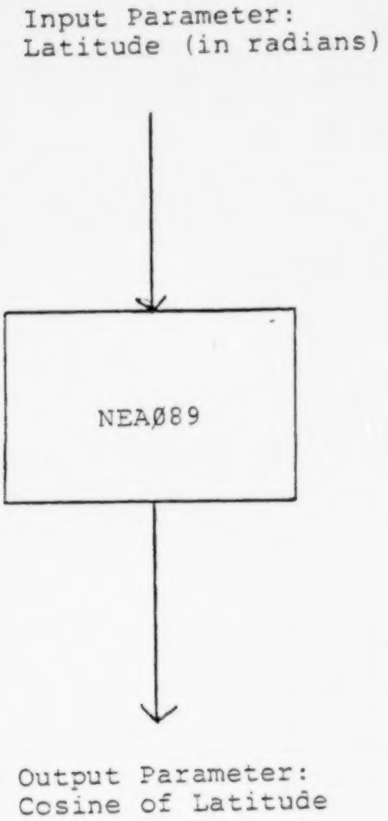
1. Descriptive Name of Component

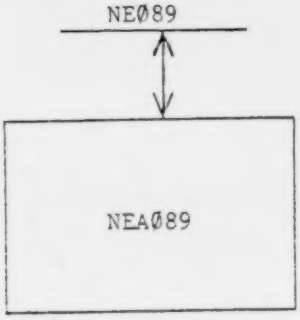
   Cosine calculation

2. Run Description

   The subprogram NEA089 is a fortran subprogram that calculates the cosine of a number held in common storage and replaces the number with its cosine.

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NEA089 SECTION: System Chart	SECTION 2 PAGE 1 DATE 9/1/78


Input Parameter:
Latitude (in radians)
NEA089
Output Parameter:
Cosine of Latitude



Hierarchy Chart

DESCRIPTIVE NAME: Point Source Fuel Data Update

RUN DESCRIPTION

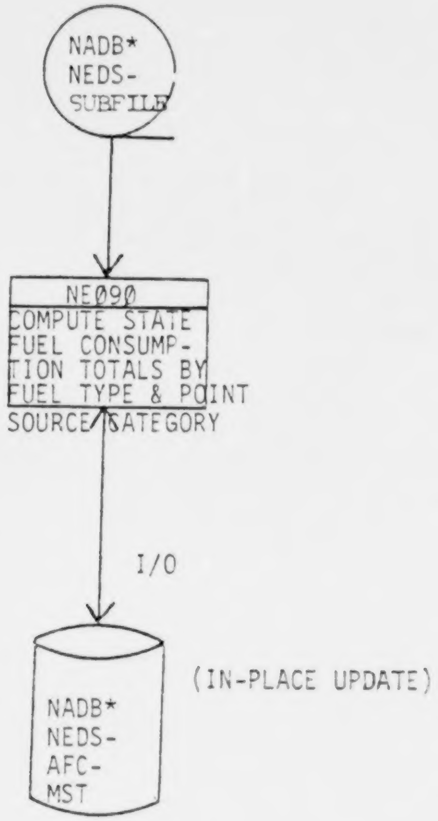
NE090 processes a tape subfile of the NEDS Point Source data base. Totals required for AFCA calculations are computed and applied to the NEDS-AFC-MST file. The program must be run once each year as part of the AFCA system's annual processing cycle.

Program NE090's only input is a tape subfile of all NEDS Point Source Records which have Source Classification Codes (SCC's) whose first three digits are: 102, 103, 202, 203, or 390. The next three digits of each record's SCC indicate the kind of fuel being consumed by the point source.

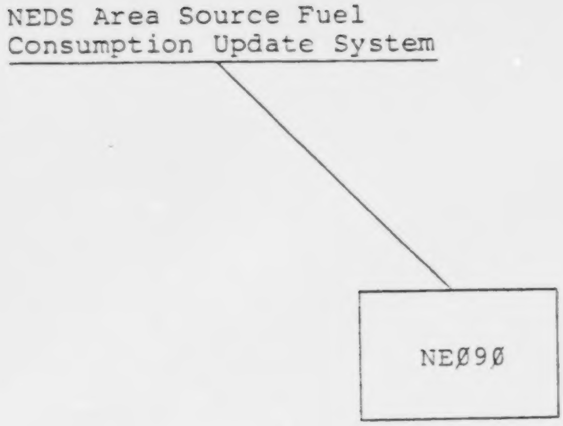
NE090 examines the "operating rate" field of the point source record to determine annual fuel consumption by the point source. Statewide point source fuel consumption totals by point source category (industrial or commercial) and fuel type are computed. If the point source record describes bituminous coal consumption, weights of sulfur and ash content are computed by the program. NE090 applies all these computed totals to the state records in NEDS-AFC-MST. (See Detailed Functional Statement 3 for a list of these totals.)

NOTE: Point source diesel consumption is added to distillate oil totals, and lignite consumption is added to bituminous totals.

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: AFCA Subsystem Flowcharts SECTION: Point Source Data Processing Diagram	SECTION 2 PAGE 1 DATE 11/30/78


NADB*
NEDS-
SUBFILE
NE090
COMPUTE STATE FUEL CONSUMPTION TOTALS BY FUEL TYPE & POINT SOURCE CATEGORY
I/O
NADB*
NEDS-
AFC-
MST
(IN-PLACE UPDATE)

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE090

DESCRIPTIVE NAME: Polk Data Update of NEDS-AFC-MST

RUN DESCRIPTION

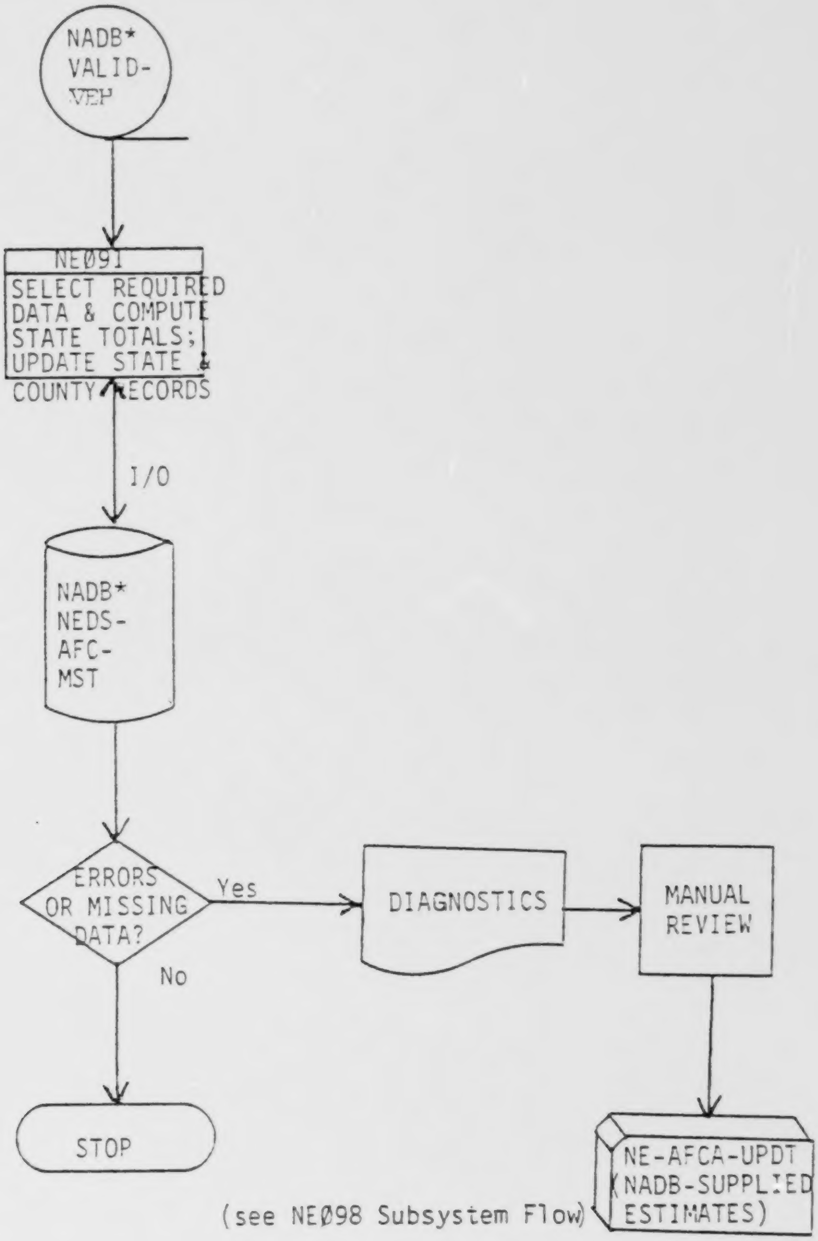
NE091 processes Polk vehicle registration counts and applies registration totals required for AFCA calculations to the NEDS-AFC-MST file. The program must be run whenever a new Polk tape is acquired by NADB and a new version of file VALID-VEH is produced by program NE082.

One tape file is input to NE091: NADB*VALID-VEH, a tape file with county records containing Polk vehicle registration counts. Selected county totals and state totals computed from them are applied as updates to state and county records in NEDS-AFC-MST.

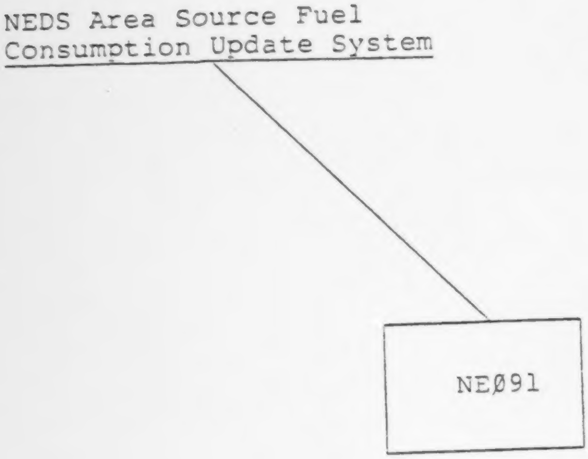
At the completion of program NE091, county records in NEDS-AFC-MST will be updated with current Polk data for the following items: total auto registrations and registered trucks ≤ 6000 lbs. Both county and state records will contain the following totals: registered trucks 6001 - 10,000 lbs.; registered trucks 10,001 - 19,500 lbs.; registered trucks 19,501 - 26,000 lbs.; and registered trucks > 26,000 lbs.

Program NE091 produces a diagnostic listing of all SAROAD counties for which some Polk data is not supplied.

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE091 SECTION: System Charts	SECTION 2 PAGE 1 DATE 12/12/78


NADB*
VALID-
VEH
NE091
SELECT REQUIRED DATA & COMPUTE STATE TOTALS; UPDATE STATE & COUNTY RECORDS
I/O
NADB*
NEDS-
AFC-
MST
ERRORS OR MISSING DATA?
Yes
No
DIAGNOSTICS
MANUAL REVIEW
STOP
NE-AFCA-UPDT (NADB-SUPPLIED ESTIMATES)
(see NE098 Subsystem Flow)

HIERARCHY CHART


NEDS Area Source Fuel
Consumption Update System
NE091

AEROS SOFTWARE	COMPONENT NAME: NE092	SECTION 1 PAGE 1
DOCUMENTATION	SECTION: AEROS Abstract	DATE July 17, 1978

1. DESCRIPTIVE NAME: CCDB Data Selector

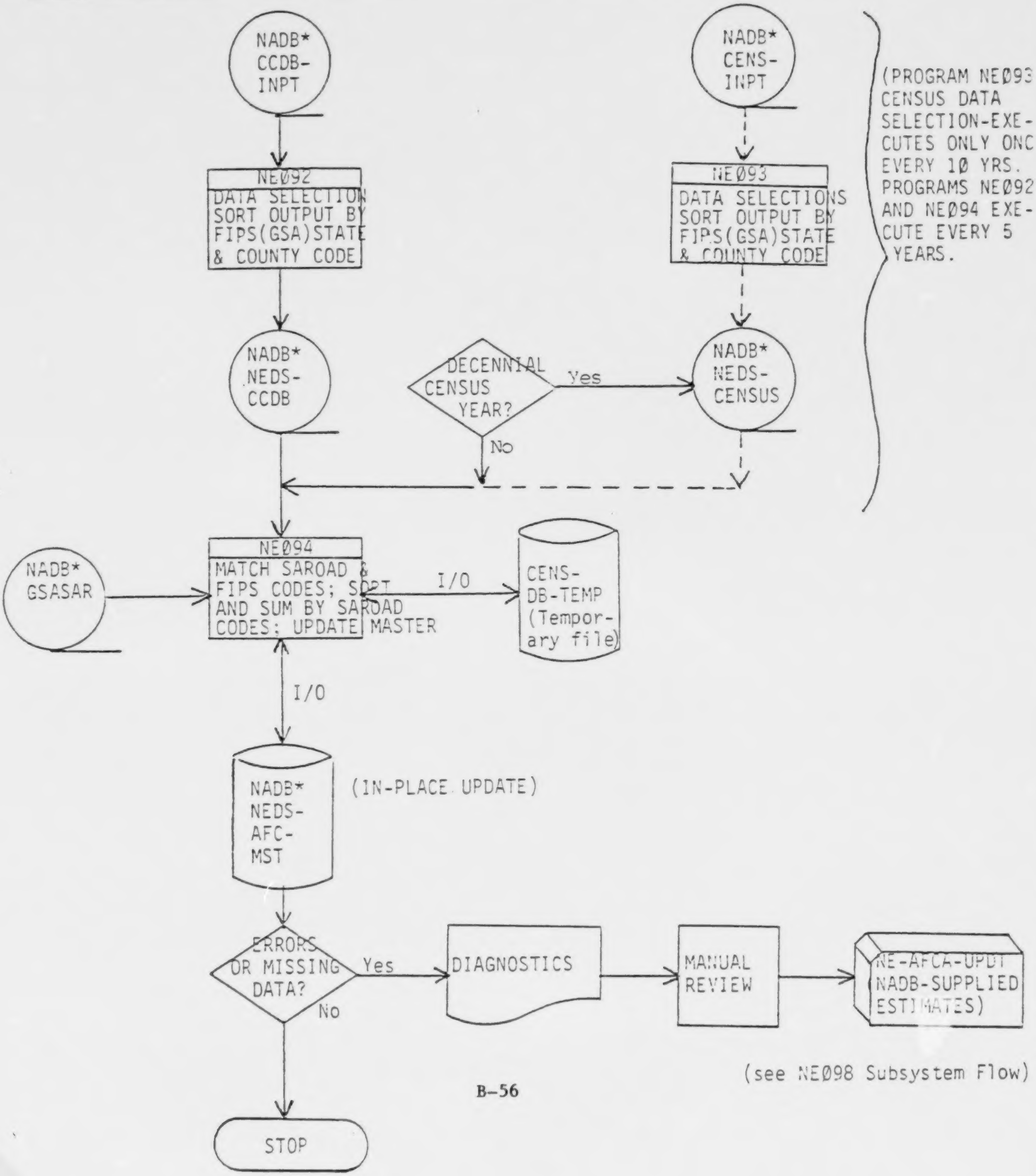
2. RUN DESCRIPTION:

NE092 processes Census Bureau data from the County and City Data Book (CCDB) tape file. The program must be run once every five years to select current CCDB data that is required as input to AFCA calculations.

The CCDB tape file is program NE092's only input. This file contains one summary U.S. total record and one record for every state, county, SMSA, urbanized area, place of 25,000 inhabitants or more. Data for AFCA calculations is selected from the summary, state and county records and written to output tape file NADB*NEDS-CCDB.

The following data items are extracted: number year-round housing units and percent of housing in single-unit structures from the summary and county records; number of farms with sales > $2500 from state records; school enrollment figures from state and county records; population, population density, and median number rooms per dwelling unit from county records. Percent of population that is urban is also extracted from the county records. This data will be summed by SAROAD county in program NE094 which also processes decennial Census of Housing data.

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE092 SECTION: System Charts	SECTION 2 PAGE 1 DATE July 17, 1978

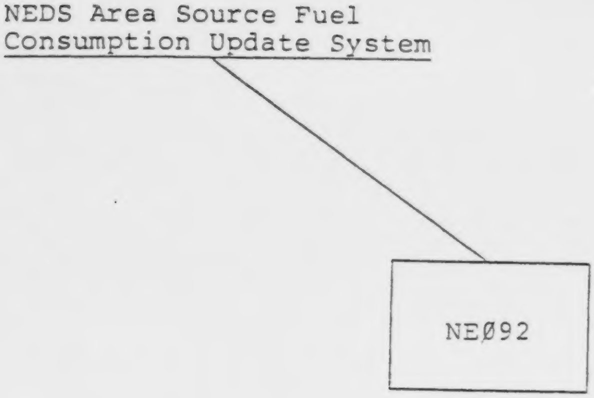

NADB*
CCDB-
INPT
NADB*
CENS-
INPT
NE092
DATA SELECTION
SORT OUTPUT BY
FIPS(GSA)STATE
& COUNTY CODE
NE093
DATA SELECTIONS
SORT OUTPUT BY
FIPS(GSA)STATE
& COUNTY CODE
NADB*
NEDS-
CCDB
DECENNIAL
CENSUS
YEAR?
Yes
No
NADB*
NEDS-
CENSUS
NE094
MATCH SAROAD &
FIPS CODES; SORT
AND SUM BY SAROAD
CODES; UPDATE MASTER
NADB*
GSASAR
I/O
CENS-
DB-TEMP
(Temporary file)
I/O
NADB*
NEDS-
AFC-
MST
ERRORS
OR MISSING
DATA?
Yes
No
DIAGNOSTICS
MANUAL
REVIEW
NE-AFCA-UPDT
(NADB-SUPPLIED
ESTIMATES)
STOP

(PROGRAM NE093 CENSUS DATA SELECTION-EXECUTES ONLY ONC EVERY 10 YRS. PROGRAMS NE092 AND NE094 EXECUTE EVERY 5 YEARS.

(IN-PLACE UPDATE)

(see NE098 Subsystem Flow)

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE092

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE093 SECTION: AEROS Abstract	SECTION 1 PAGE 1 DATE 8/8/78

1. DESCRIPTIVE NAME: CENSUS Data Selector

2. RUN DESCRIPTION:

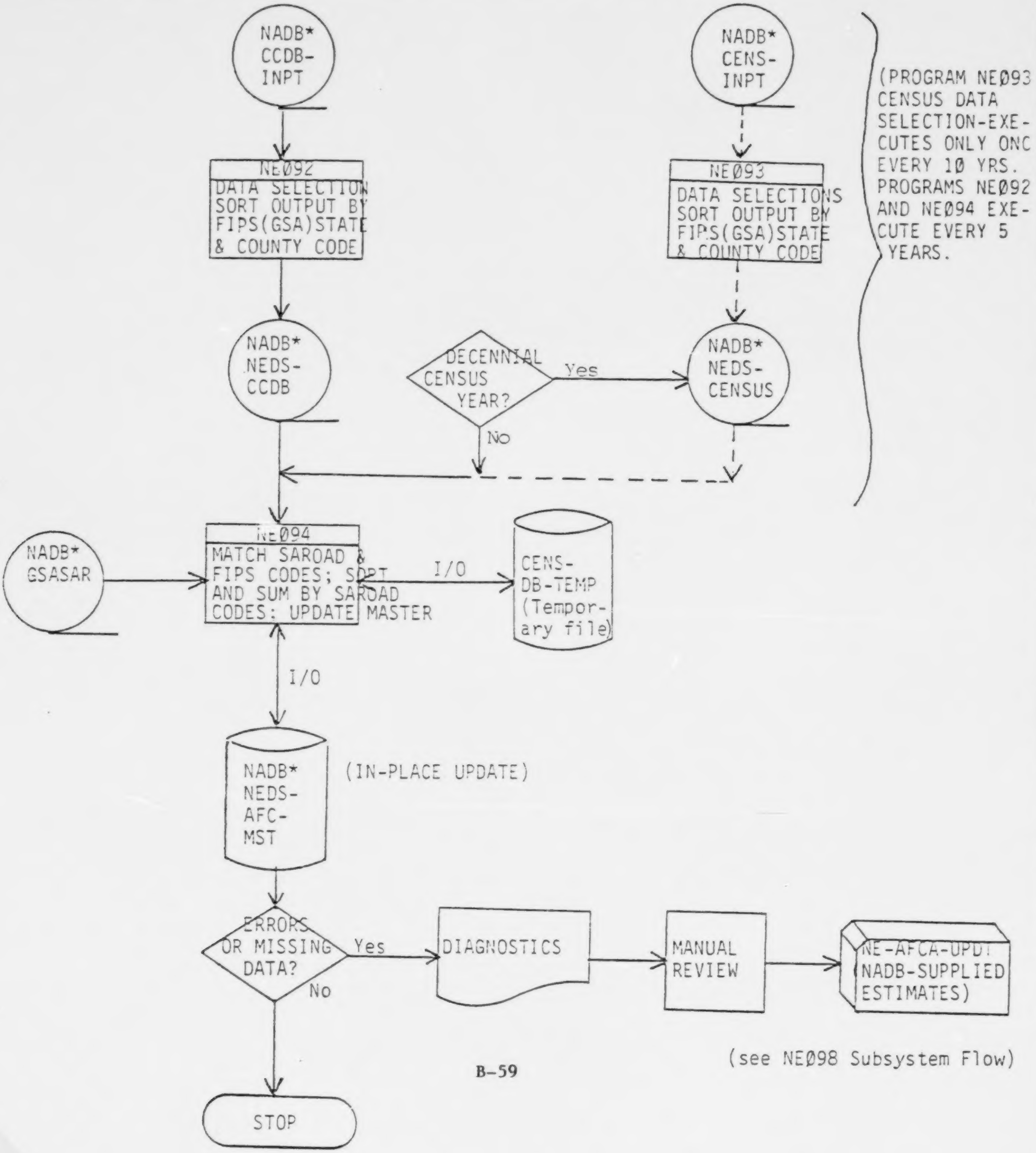
NE093, which processes decennial census data, must be run once every ten years to select AFCA calculation input data from the most recent Census of Housing.

The CENSUS tape file is NE093's only input. Data for AFCA calculations is selected from state and county records and written to output tape file NADB*NEDS-CENSUS.

The following data items are extracted: population and number of housing units w/gas heat (a summation of six separate figures) from the state records; population; count of occupied housing units by cooking fuel; count of occupied housing units by water-heating fuel and count of occupied housing units by house-heating fuel from the county records.

This data will be summed by SAROAD county in program NE094 which also processes decennial Census of Housing data.

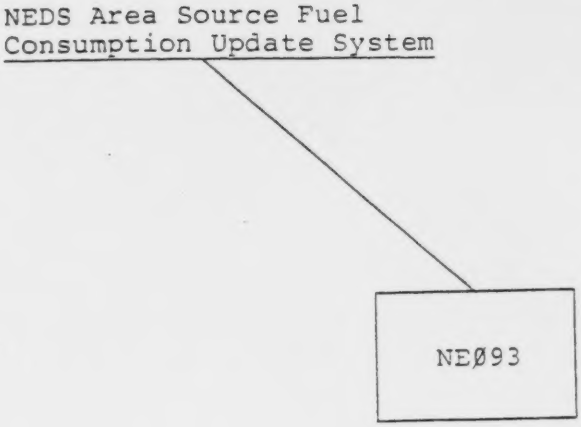
AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE093 SECTION: System Charts	SECTION 2 PAGE 1 DATE 8/8/78


NADB*
CCDB-
INPT
NE092
DATA SELECTION
SORT OUTPUT BY
FIPS(GSA)STATE
& COUNTY CODE
NADB*
NEDS-
CCDB
NADB*
CENS-
INPT
NE093
DATA SELECTIONS
SORT OUTPUT BY
FIPS(GSA)STATE
& COUNTY CODE
DECENNIAL
CENSUS
YEAR?
Yes
No
NADB*
NEDS-
CENSUS
(PROGRAM NE093
CENSUS DATA
SELECTION-EXE-
CUTES ONLY ONC
EVERY 10 YRS.
PROGRAMS NE092
AND NE094 EXE-
CUTE EVERY 5
YEARS.
NADB*
GSASAR
NE094
MATCH SAROAD &
FIPS CODES; SORT
AND SUM BY SAROAD
CODES: UPDATE MASTER
I/O
CENS-
DB-TEMP
(Temporary file)
I/O
NADB*
NEDS-
AFC-
MST
(IN-PLACE UPDATE)
ERRORS
OR MISSING
DATA?
Yes
No
DIAGNOSTICS
MANUAL
REVIEW
NE-AFCA-UPDT
(NADB-SUPPLIED
ESTIMATES)
STOP

(see NE098 Subsystem Flow)

AEROS SOFTWARE	COMPONENT NAME: NE093	SECTION 2 PAGE 2
DOCUMENTATION	SECTION: System Charts	DATE October 8, 1978

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE093

DESCRIPTIVE NAME: CCDB/Census Data Update of NEDS-AFC-MST

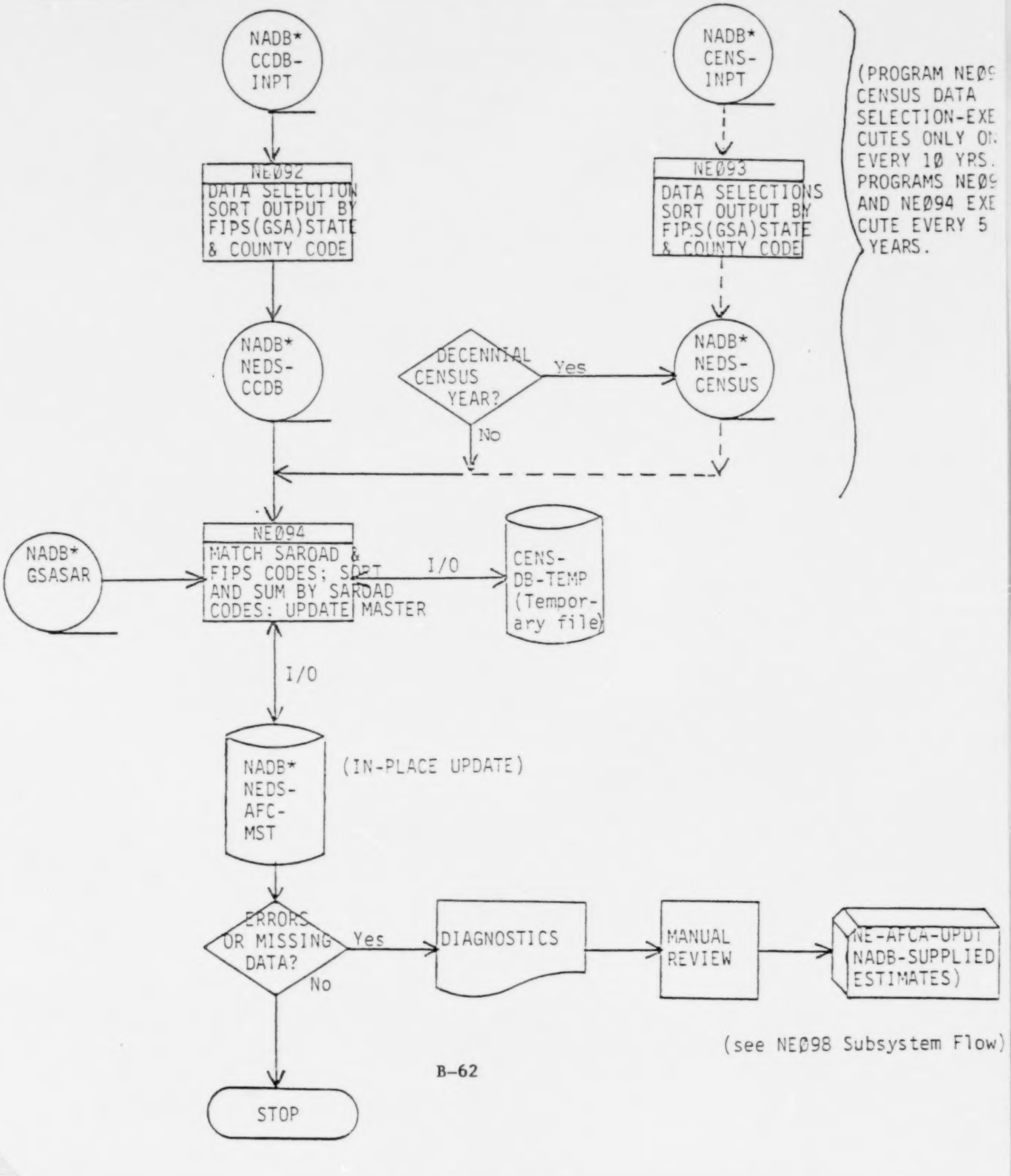
RUN DESCRIPTION

NE094 processes Census Bureau data from the CCDB file and the decennial Census of Housing file. Selected data items are summed by SAROAD county and applied to file NEDS-AFC-MST as an update. The program must be run once every five years to apply the most recent CCDB data to NEDS-AFC-MST. In alternating runs (every ten years), Census of Housing data also is processed.

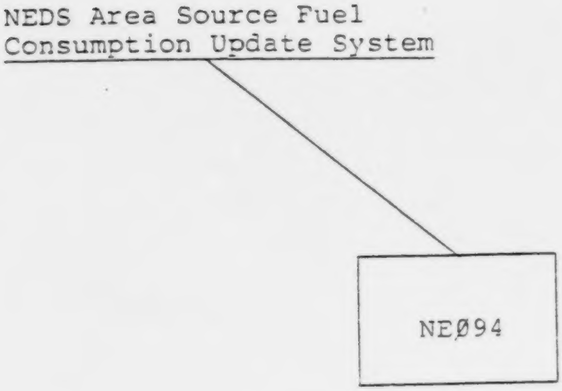
NE094 has up to three input sources. Two tape files are input to every execution of the program: NEDS-CCDB which is output by program NE092, and GSASAR which contains GSA-SAROAD state and county code cross references. A third tape file is input only to every other execution of NE094: NEDS-CENSUS which is output by program NE093.

GSA county and state records on files NEDS-CCDB and NEDS-CENSUS are matched to SAROAD county and state codes in file GSASAR. Data records are then sorted by SAROAD codes and summed by SAROAD county and state before being applied to state and county records of NEDS-AFC-MST.

NE094 produces diagnostic messages when: there is no matching SAROAD code on file GSASAR for a county or state record on file NEDS-CCDB or file NEDS-CENSUS or, a SAROAD state or county code on GSASAR has no matching data in either file NEDS-CCDB or NEDS-CENSUS.


NADB* CCDB-INPT
NADB* CENS-INPT
(PROGRAM NE09
CENSUS DATA
SELECTION-EXE
CUTES ONLY ON
EVERY 10 YRS.
PROGRAMS NE09
AND NE094 EXE
CUTE EVERY 5
YEARS.
NE092
DATA SELECTION
SORT OUTPUT BY
FIPS(GSA)STATE
& COUNTY CODE
NE093
DATA SELECTIONS
SORT OUTPUT BY
FIPS(GSA)STATE
& COUNTY CODE
NADB* NEDS-CCDB
DECENNIAL CENSUS YEAR?
Yes
No
NADB* NEDS-CENSUS
NADB* GSASAR
NE094
MATCH SAROAD & FIPS CODES; SORT AND SUM BY SAROAD CODES: UPDATE MASTER
I/O
CENS-DB-TEMP (Temporary file)
I/O
NADB* NEDS-AFC-MST
(IN-PLACE UPDATE)
ERRORS OR MISSING DATA?
Yes
No
DIAGNOSTICS
MANUAL REVIEW
NE-AFCA-UPDT (NADB-SUPPLIED ESTIMATES)
(see NE098 Subsystem Flow)
STOP

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE094

AEROS SOFTWARE **DOCUMENTATION**	**COMPONENT NAME:** NE095 **SECTION:** AEROS Abstract	**SECTION** 1 **PAGE** 1 **DATE** 11/30/78

DESCRIPTIVE NAME: Summed County Data Update of NEDS-AFC-MST

RUN DESCRIPTION

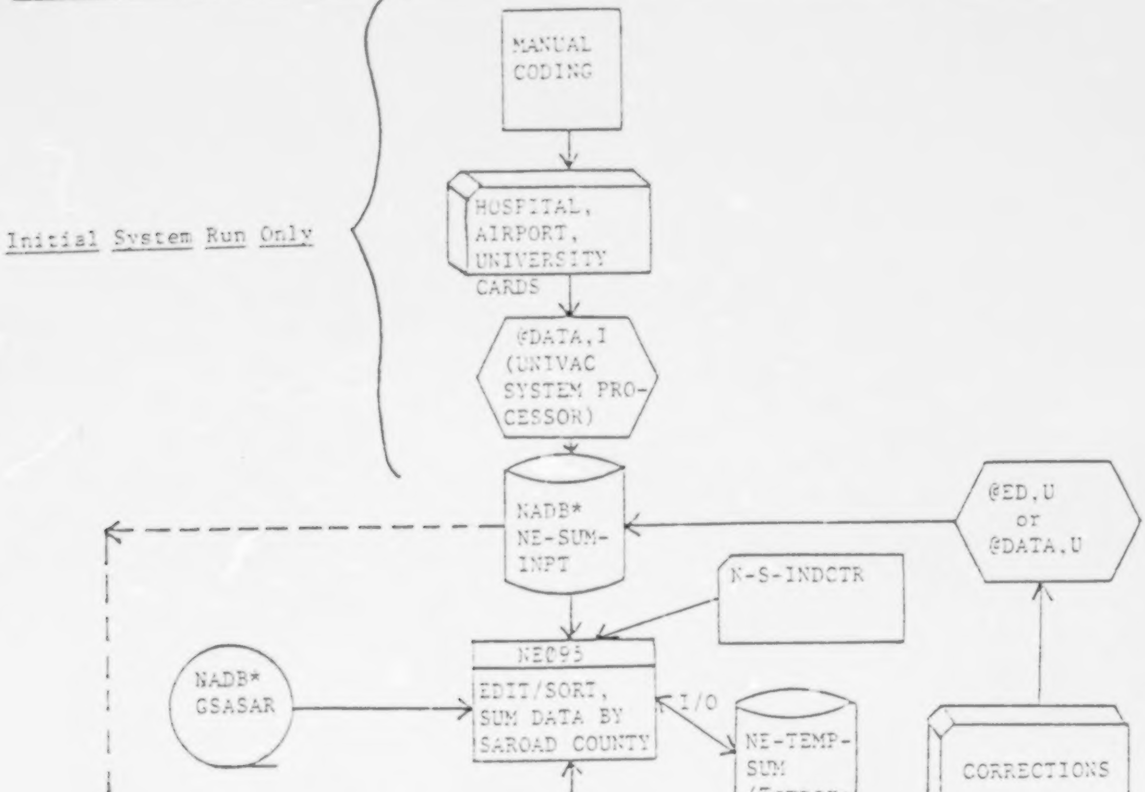
NE095 processes card-image data on hospitals, universities and aircraft operations. Data is summed by SAROAD county and applied as updates to the county records of NEDS-AFC-MST. The program must be executed during the initial annual run of the AFCA system; in all subsequent AFCA processing cycles NE095 is run only if changes to its card input are made.

NE095 has three sources of input: the GSASAR tape file, which contains a county name-SAROAD code cross-reference, a disk file containing card-image data for individual hospitals, universities and airports, and a parameter card specifying a national or selected states only run. Card-image data is sorted by county name and card type, and edited for numeric values. County names are matched to SAROAD county codes on file GSASAR, and data items are summed and applied to county records on NEDS-AFC-MST.

At the completion of program NE095, NEDS-AFC-MST county records (for all states processed) will contain the county name from GSASAR and current data for the following items: number operations for commercial, general and military aviation; number hospital beds and hospital employees; and university enrollment.

Program NE095 produces diagnostic messages when: invalid (non-numeric) data is supplied; there is no matching SAROAD code for an input county name; or a SAROAD county code on GSASAR has no matching data in the input data file.

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: AFCA Subsystem SECTION: Program NE095 Subsystem Diagram	SECTION 2 PAGE 1 DATE 11/30/78



Initial System Run Only
MANUAL CODING
HOSPITAL, AIRPORT, UNIVERSITY CARDS
@DATA,I (UNIVAC SYSTEM PROCESSOR)
NADB* NE-SUM-INPT
@ED,U or @DATA,U
N-S-INDCTR
NE095
EDIT/SORT, SUM DATA BY SAROAD COUNTY
NADB* GSASAR
I/O
NE-TEMP-SUM (Temporary file)
CORRECTIONS
NADB* NEDS-AFC-MST
(IN-PLACE UPDATE)
ERRORS?
No
Yes
DIAGNOSTICS
NADB* NE-SUM INPT
@COPY,G (UNIVAC SYSTEM PROCESSOR)
NADB* NE-SI-TP
(Stored; @COPY,G'd to NE-SUM-INPT and updates applied via @ED,U or @DATA,U for next NE095 cycle)

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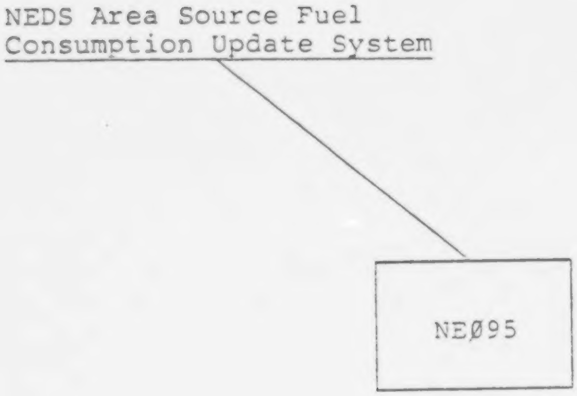
HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE095

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE096 SECTION: AEROS Abstract	SECTION 1 PAGE 1 DATE 12/15/78

DESCRIPTIVE NAME: Card Edit and Update of NEDS-AFC-MST

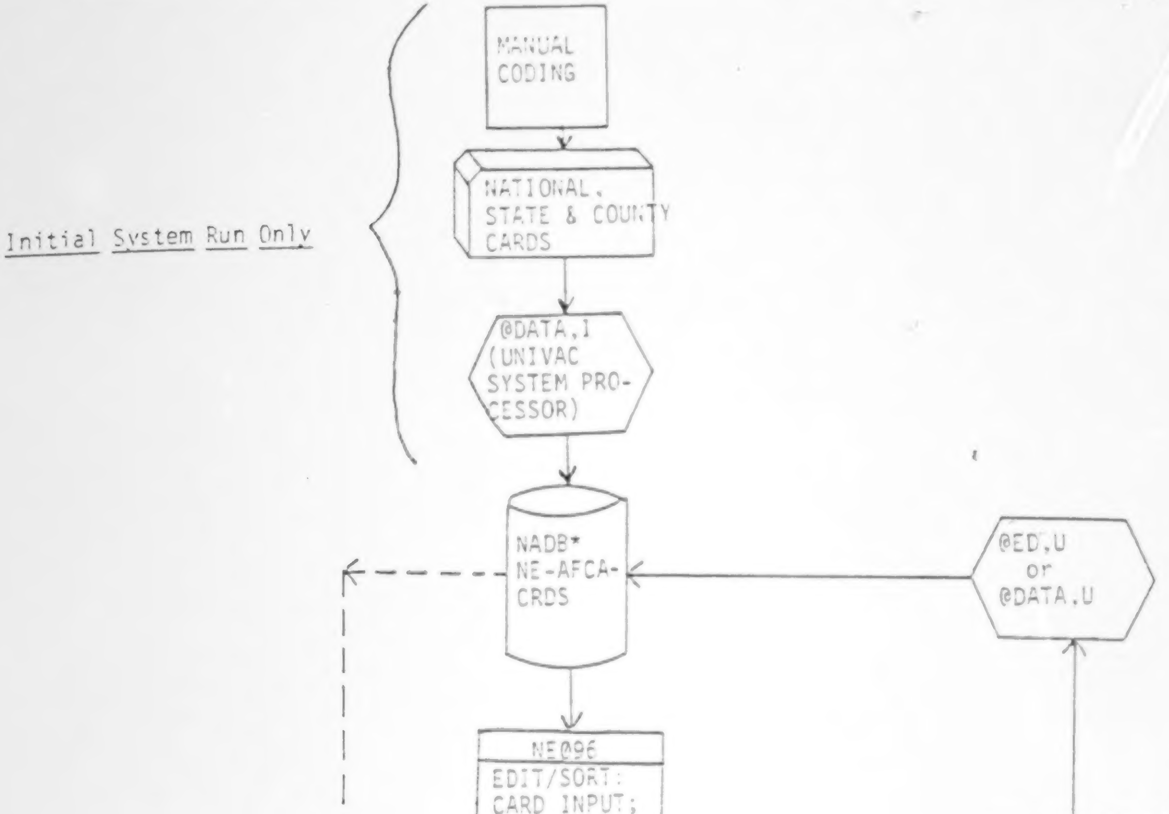
RUN DESCRIPTION

NE096 processes manually prepared card-image data from government and private publications and applies it to national, state and county records on NEDS-AFC-MST. The program must be run once each year; NE096 may also execute during special state runs if changes are made to its input data.

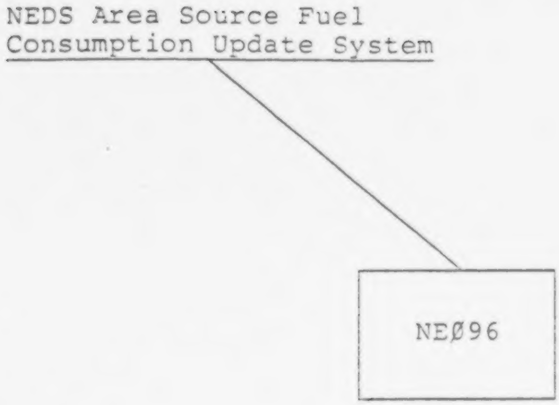
NE096's only input is a disk file containing national, state and county card-image records with data on population, geography and fuel consumption. This data is edited for numeric values and sorted by nation, state, county, and card type before it is applied to NEDS-AFC-MST records.

NEDS-AFC-MST and the card data are matched sequentially by program NE096. Diagnostic messages are produced when: invalid (non-numeric) data is supplied; there is no NEDS-AFC-MST record that matches a data card; or input data is not supplied for a record on NEDS-AFC-MST.

AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME [illegible] SECTION: System Charts	SECTION 1 PAGE 1 DATE 12/15/78


MANUAL CODING
NATIONAL, STATE & COUNTY CARDS
Initial System Run Only
@DATA,I (UNIVAC SYSTEM PROCESSOR)
NADB* NE-AFCA-CRDS
@ED,U or @DATA,U
NE096
EDIT/SORT: CARD INPUT; MATCH WITH MASTER
I/O
(IN-PLACE UPDATE)
NADB* NEDS-AFC-MST
CORRECTIONS
NADB* NE-AFCA CRDS
No
ERRORS?
Yes
DIAGNOSTICS
@COPY,G (UNIVAC SYSTEM PROCESSOR)
NADB* NE-CRDS-TP
(Stored; @COPY,G'd to NE-AFCA-CRDS and updates applied via @ED,U or @DATA,U for next NE096 cycle)

HIERARCHY CHART


NEDS Area Source Fuel
Consumption Update System
NE096

AEROS SOFTWARE DOCUMENTATION	**COMPONENT NAME:** NE097 **SECTION:** AEROS Abstract	**SECTION** 1 **PAGE** 1 **DATE** 1/19/79

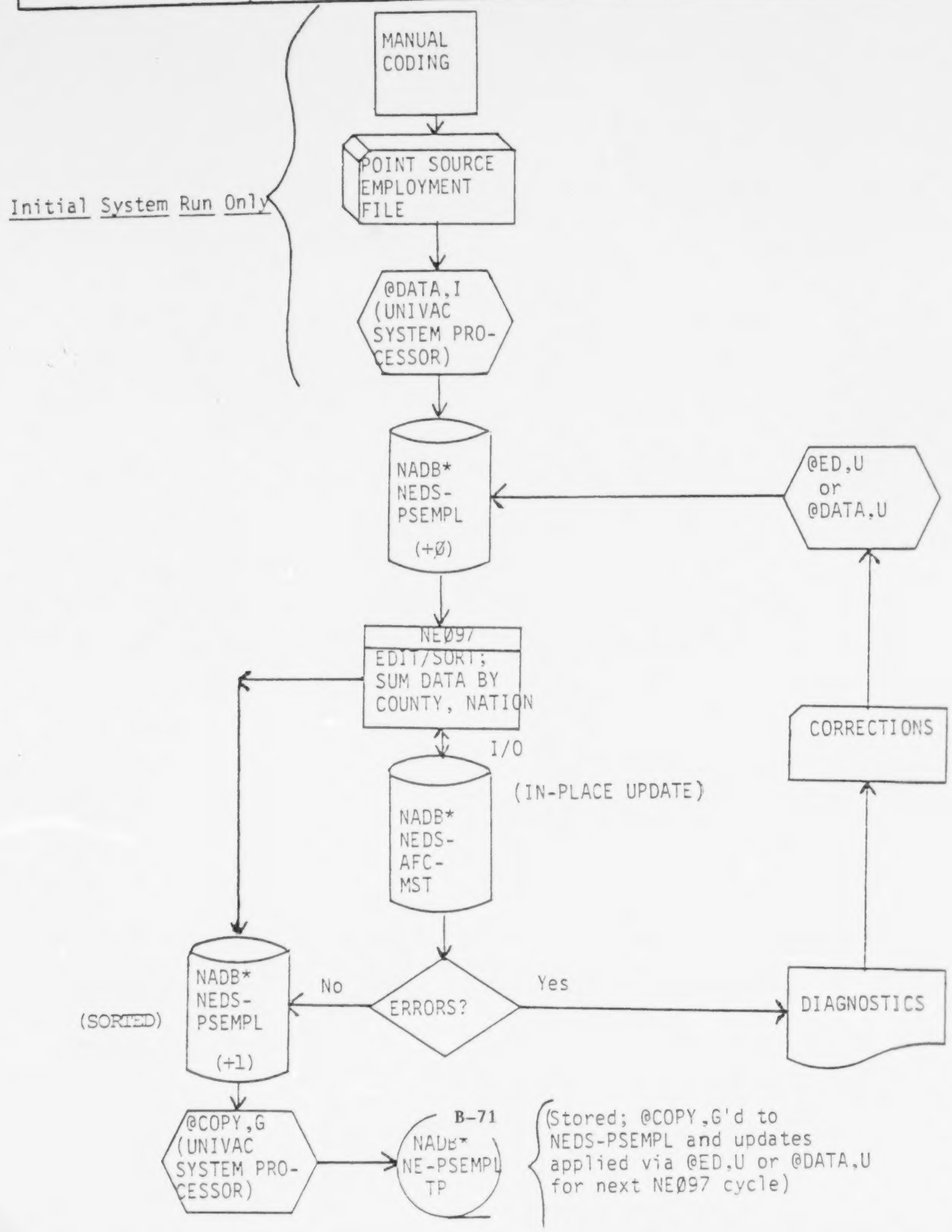
DESCRIPTIVE NAME: Point Source Employment Update of NEDS-AFC-MST

RUN DESCRIPTION

NE097 processes card-image data on point source employment and applies it as updates to the national and county records of NEDS-AFC-MST. The program must be run once each year. NE097 also may execute in special runs for individual states if changes are made to the point source employment file.

NE097's only input is a disk file containing card-image records of employment data for individual industrial facilities. Each record contains a county code, SIC code, and the number of employees for an industrial plant that has been identified by NADB as a point source. This data is sorted by State, County, Plant I.D., and SIC codes and edited for numeric values. Employment figures are summed by SIC by nation and county and applied to NEDS-AFC-MST records. County records on NEDS-AFC-MST are updated with current point source employment totals for SIC's 20-39; national and county records are updated with point source employment totals for solvent-user SIC's.

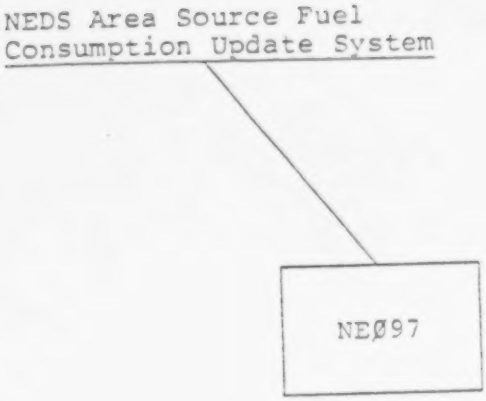
Program NE097 produces diagnostic messages when: non-numeric data is supplied; there is no NEDS-AFC-MST county record that matches a data card; input data is not supplied for a county record on NEDS-AFC-MST; or duplicate input records are supplied.



Initial System Run Only
MANUAL CODING
POINT SOURCE EMPLOYMENT FILE
@DATA,I (UNIVAC SYSTEM PROCESSOR)
NADB* NEDS-PSEMPL (+0)
@ED,U or @DATA,U
NE097
EDIT/SORT; SUM DATA BY COUNTY, NATION
I/O
(IN-PLACE UPDATE)
NADB* NEDS-AFC-MST
CORRECTIONS
No
ERRORS?
Yes
DIAGNOSTICS
(SORTED)
NADB* NEDS-PSEMPL (+1)
@COPY,G (UNIVAC SYSTEM PROCESSOR)
NADB* NE-PSEMPL TP
(Stored; @COPY,G'd to NEDS-PSEMPL and updates applied via @ED,U or @DATA,U for next NE097 cycle)

AEROS SOFTWARE	COMPONENT NAME: NE097	SECTION 2 PAGE 2
DOCUMENTATION	SECTION: System Charts	DATE 01/19/79

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE097

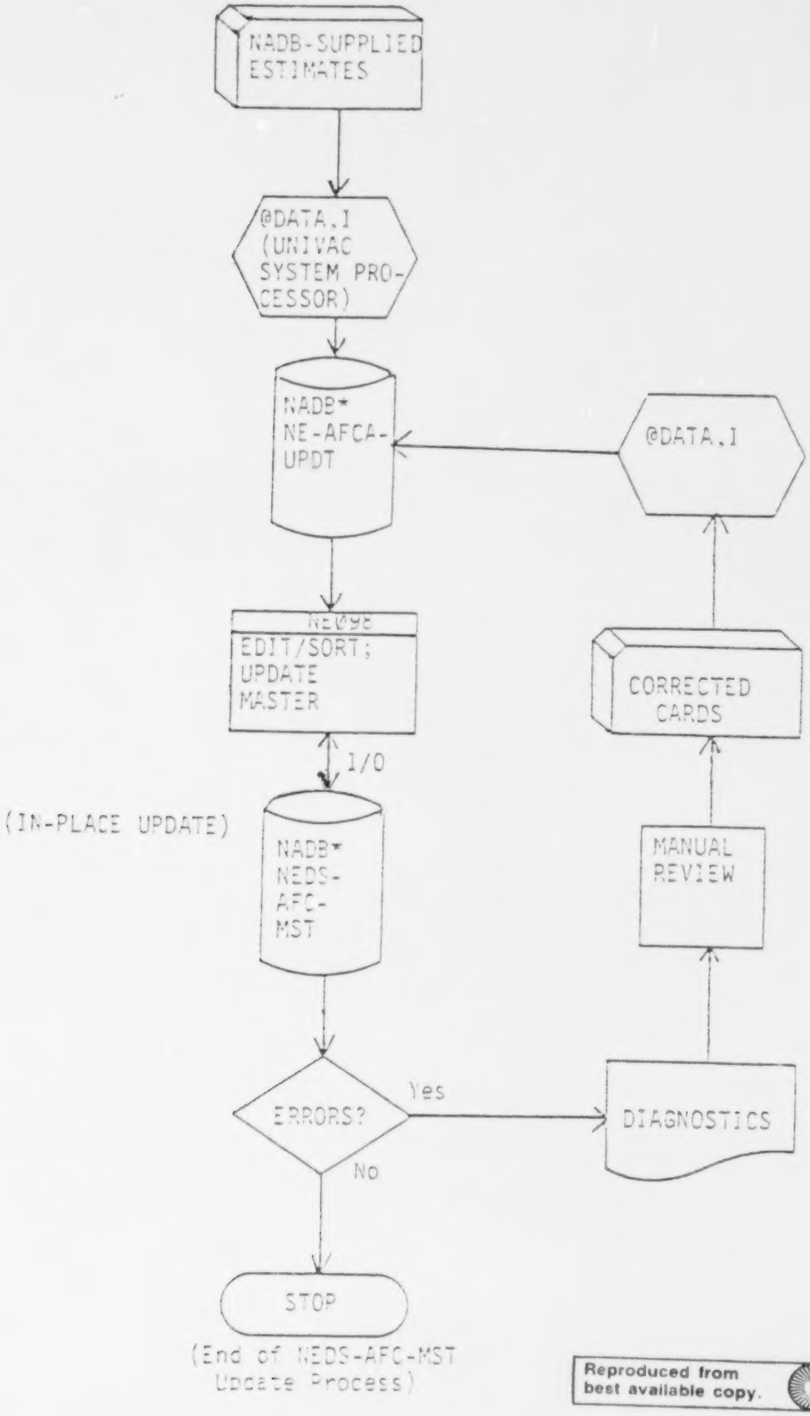
DESCRIPTIVE NAME: Correction Update of NEDS-AFC-MST

RUN DESCRIPTION

NE098 processes manually prepared card-image data and applies it as updates to NEDS-AFC-MST records. This program, which enables NADB to provide its own estimates for data items required for AFCA calculations, is executed at NADB's discretion during both annual and special statewide processing cycles of the AFCA system.

NE098's only input is a correction card deck which is prepared during a review of diagnostic listings produced by programs NE087, NE089, NE091, and NE094. These card-image records contain: a key (SAROAD State and County codes) which identifies the record to be updated; a code which identifies which data item is being supplied and the numeric value which is to be inserted into or added to a data item on the record. This input data will be sorted by nation, state, and county before it is applied to records on NEDS-AFC-MST in order to avoid multiple accesses of the same record.

Execution of program NE098 completes the updating process for file NEDS-AFC-MST and the collection of all data required to perform the allocation calculations of the AFCA system.



NADB-SUPPLIED ESTIMATES
@DATA,I (UNIVAC SYSTEM PRO-CESSOR)
NADB* NE-AFCA-UPDT
@DATA,I
NE098
EDIT/SORT; UPDATE MASTER
CORRECTED CARDS
I/O
(IN-PLACE UPDATE)
NADB* NEDS-AFC-MST
MANUAL REVIEW
ERRORS?
Yes
No
DIAGNOSTICS
STOP
(End of NEDS-AFC-MST Update Process)

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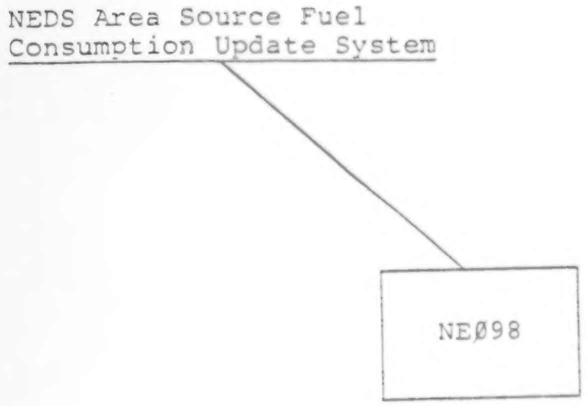
HIERARCHY CHART


NEDS Area Source Fuel
Consumption Update System
NE098

AEROS SOFTWARE DOCUMENTATION	**COMPONENT NAME:** NE099 **SECTION:** AEROS Abstract	**SECTION** 1 **PAGE** 1 **DATE** 3/2/79

DESCRIPTIVE NAME: Area Fuel Consumption Allocation

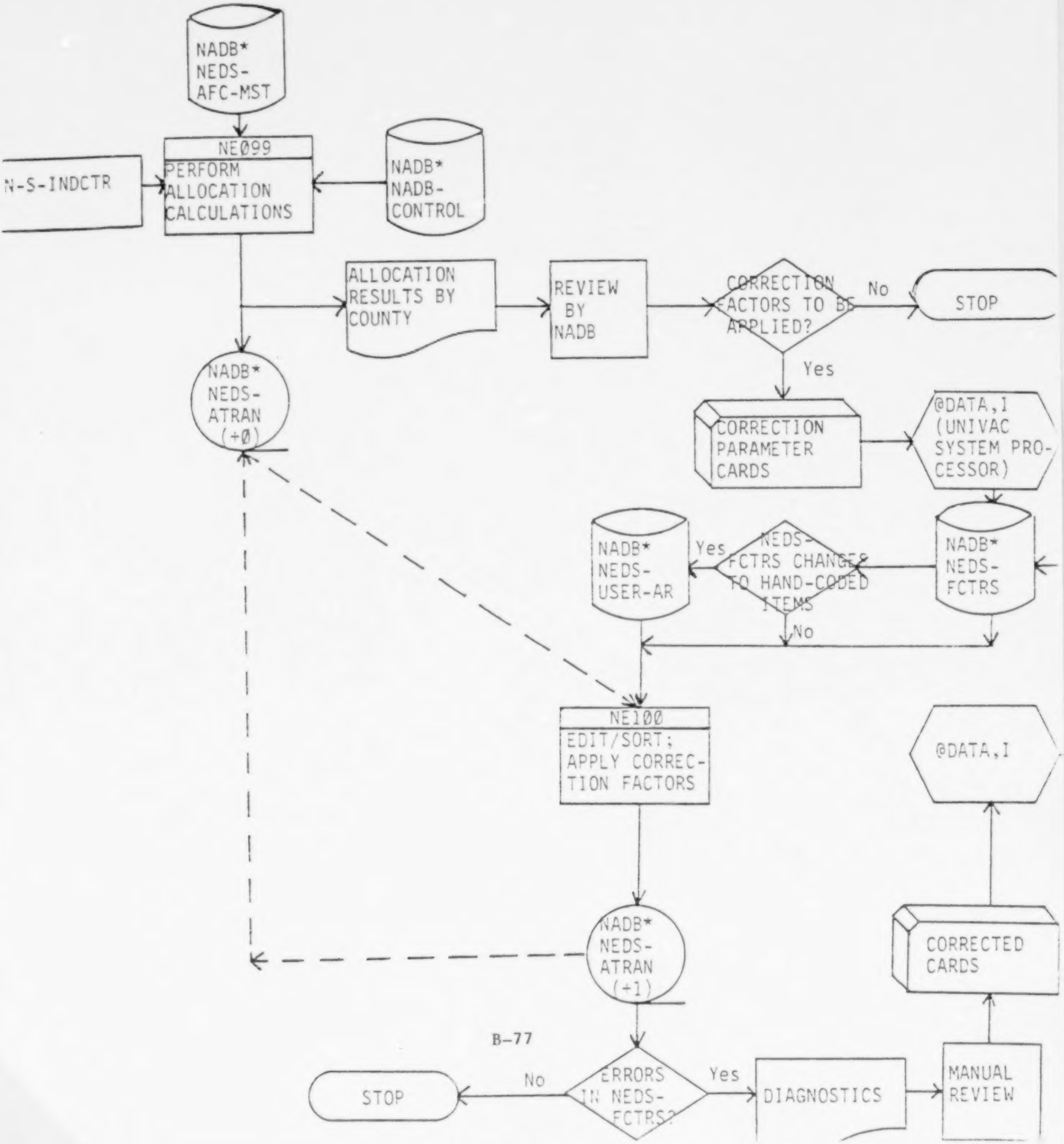
RUN DESCRIPTION

NE099 performs calculations which compute county-wide fuel consumption estimates. The program must be run once each year and also executes during special statewide system runs.

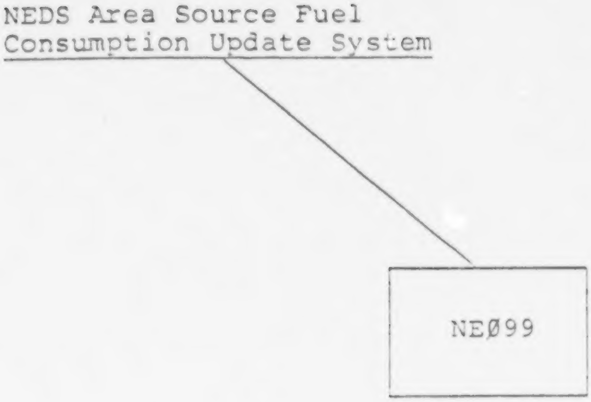
NE099 has three sources of input: a parameter card, the NEDS-AFC-MST file, and the NADB*CONTROL disk file. The parameter card indicates whether the program produces consumption estimates for all SAROAD counties or only for counties within specified states. File NADB*CONTROL contains data items used in program calculations that are relatively stable and are updated only on an "as required" basis by NADB. NEDS-AFC-MST contains all other data needed to perform NE099's county-wide allocation calculations.

Data in NEDS-AFC-MST is processed sequentially as program NE099 executes calculations which: adjust input totals by subtracting point source data to obtain area source values; estimate county area consumption values; and normalize these county estimates so that the sum of all counties within a state does not exceed a published state total.

Computed county results are output to a tape file (NEDS-ATRAN) containing four card-image records per SAROAD county and to a formatted report. Computed county results also are summed by state and written to a state totals page of the output report after results for all counties within the state have been printed.


NADB*
NEDS-
AFC-MST
N-S-INDCTR
NE099
PERFORM
ALLOCATION
CALCULATIONS
NADB*
NADB-
CONTROL
ALLOCATION
RESULTS BY
COUNTY
REVIEW
BY
NADB
CORRECTION
FACTORS TO BE
APPLIED?
No
STOP
Yes
NADB*
NEDS-
ATRAN
(+0)
CORRECTION
PARAMETER
CARDS
@DATA,I
(UNIVAC
SYSTEM PRO-
CESSOR)
NADB*
NEDS-
USER-AR
Yes
NEDS-
FCTRS CHANGES
TO HAND-CODED
ITEMS
No
NADB*
NEDS-
FCTRS
NE100
EDIT/SORT;
APPLY CORREC-
TION FACTORS
@DATA,I
NADB*
NEDS-
ATRAN
(+1)
CORRECTED
CARDS
STOP
No
ERRORS
IN NEDS-
FCTRS?
Yes
DIAGNOSTICS
MANUAL
REVIEW

HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE099

Detailed Program Narrative

Program NE099

Program NE099 is the major calculation program in the AFCA system. The program is run once each year to perform calculations which compute county-wide fuel consumption estimates. NE099 may also execute during special runs which compute county estimates only for selected states.

NE099 has three sources of input: a parameter card (N-S-INDCTR); the AFCA system master file (NEDS-AFC-MST); and the NADB-CONTROL disk file. The parameter card indicates whether the program is to produce consumption estimates for all SAROAD counties or only for counties within states that are specified on the card (up to fifteen states in any one program execution). File NADB-CONTROL contains three source elements (USER-PRCNT, FHA-MILES, and RU-MI-NDX) which consist of card-image input data used in calculations. NEDS-AFC-MST is an indexed sequential file which contains all other data needed as input to the AFCA calculations. File NEDS-AFC-MST contains one national data record and one data record for each SAROAD state followed by a data record for every SAROAD county or county equivalent within that state. Data records on file NEDS-AFC-MST are sequenced by SAROAD state/county codes; they are accessed dynamically by program NE099. (i.e., The records may be read and processed either randomly or sequentially in the order in which they occur on the file.)

Program NE099 begins processing by reading and validating the parameter card. If errors are detected on the card, an error message is printed and the run is aborted; otherwise, processing continues and the national record of file NEDS-AFC-MST is read in by the program. National data is moved to an internal storage area where it may be accessed as needed by program calculations. Calculation input data contained in file NADB-CONTROL is then read in and also stored internally for later use. Program NE099 then performs some preliminary calculations with national level data to obtain values that will be used as input to the county allocation calculations. (e.g., National consumption of seventeen solvent-types is computed for eighteen different solvent-user categories.)

When these preliminary calculations are completed, program NE099 begins to perform allocation calculations one state at a time. If program execution is for an annual national run all states on file NEDS-AFC-MST are processed; if execution is a special run for selected state(s), the file is positioned at the beginning of data for the selected states and data for all non-selected states is bypassed. State level data for the current state is moved to an internal storage area to be accessed as needed by county calculations. Some preliminary calculations with state data are performed, such as the computation of Industrial Fuel Intensity Ratios (FIR's) for the state being processed. Control is then passed to the FOUR-PASSES routine which will sequentially process all the county records for the current state in four separate passes as required by AFCA calculations.

FOUR-PASSES controls execution of four subordinate routines which sequentially read and process county records within the current state. Each of these subordinate routines (PASS-ONE through PASS-FOUR) is performed the same number of times as there are counties within the state.

File NEDS-AFC-MST is positioned at the beginning of data for the current state each time one of the subordinate routines is called.

PASS-ONE computes several values required in later passes plus the following final estimates:

1. LTO Cycles for Military, Civilian and Commercial Aircraft.
2. Off-Highway Diesel Consumption.
3. Marine Vessel Gasoline Consumption.
4. Railroad Diesel Consumption.
5. Heavy-Duty Vehicle Diesel and Gasoline Consumption.
6. Light-Duty Vehicle Gasoline Consumption (for counties of states that report annual vehicle miles by county).
7. Residential Distillate Oil Consumption.
8. Organic Solvent Consumption

As each of these county values are computed, they are stored in an internal table which holds all results for all counties within one state and they are added to respective state totals. When PASS-ONE has been executed for all counties within the state, control is returned to the FOUR-PASSES routine.

FOUR-PASSES then calculates five state level values required in PASS-TWO and passes control to that routine.

PASS-TWO computes the following estimates for each county within the state:

1. Off-Highway Gasoline Consumption.
2. Retail Gasoline Sales.
3. Light-Duty Vehicle Gasoline Consumption (for counties of states not reporting annual vehicle miles by county).
4. Residential Bituminous and Anthracite Coal Consumption.
5. Industrial Consumption of Residual Oil, Distillate Oil, Natural Gas and Bituminous Coal.

When PASS-TWO has completed values for all counties within the state, it passes control back to FOUR-PASSES which computes six values needed by PASS-THREE.

PASS-THREE computes county estimates of Residential Natural Gas Consumption. It then accumulates six totals relating to "special" commercial categories consumption of natural gas, LPG, anthracite and bituminous coal and residual and distillate oil. These values are used following PASS-THREE and in PASS-FOUR.

FOUR-PASSES then calculates 12 values required in PASS-FOUR and passes control to that routine.

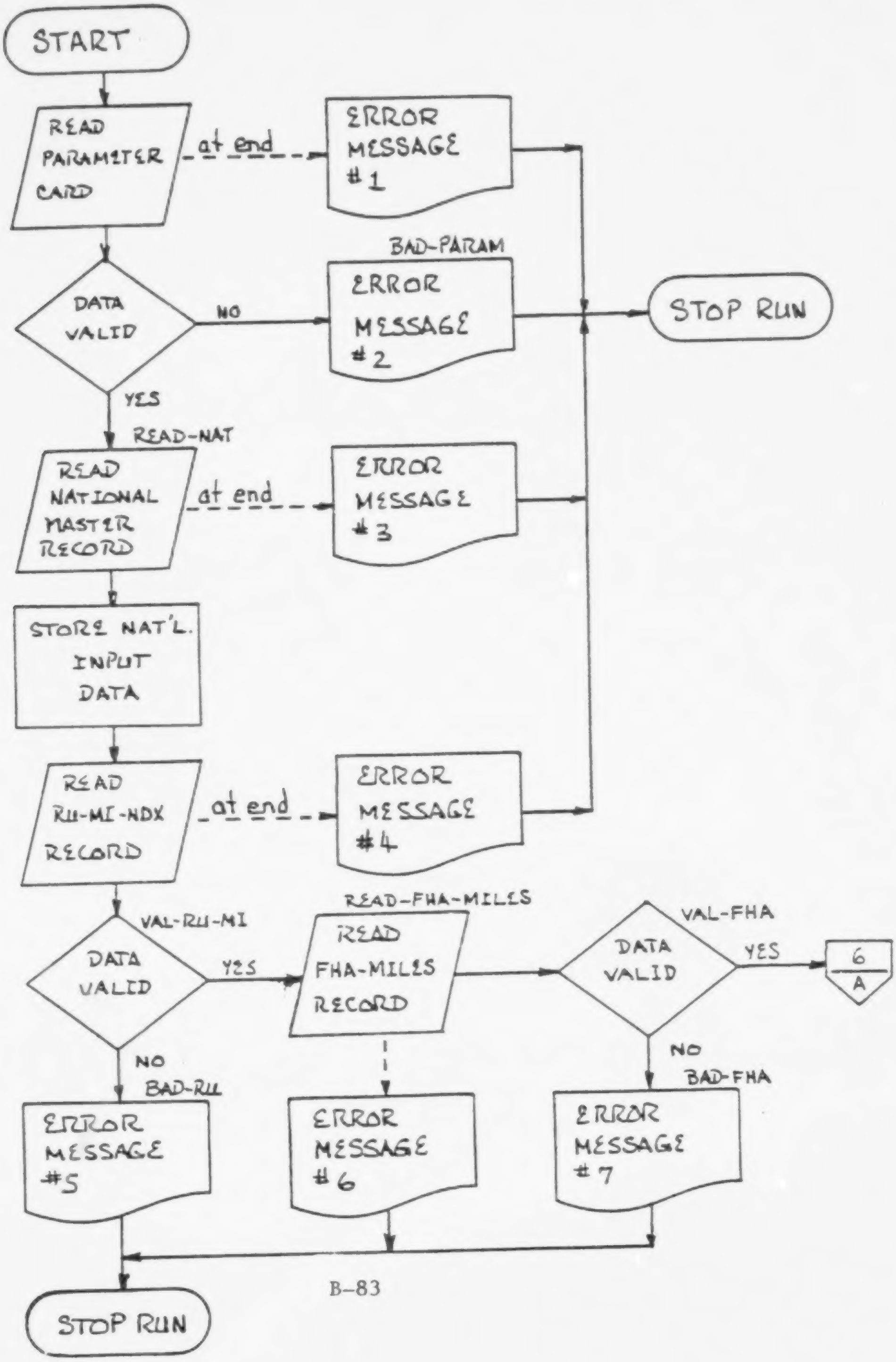
PASS-FOUR then completes the state processing by computing the following estimates for each county within the state:

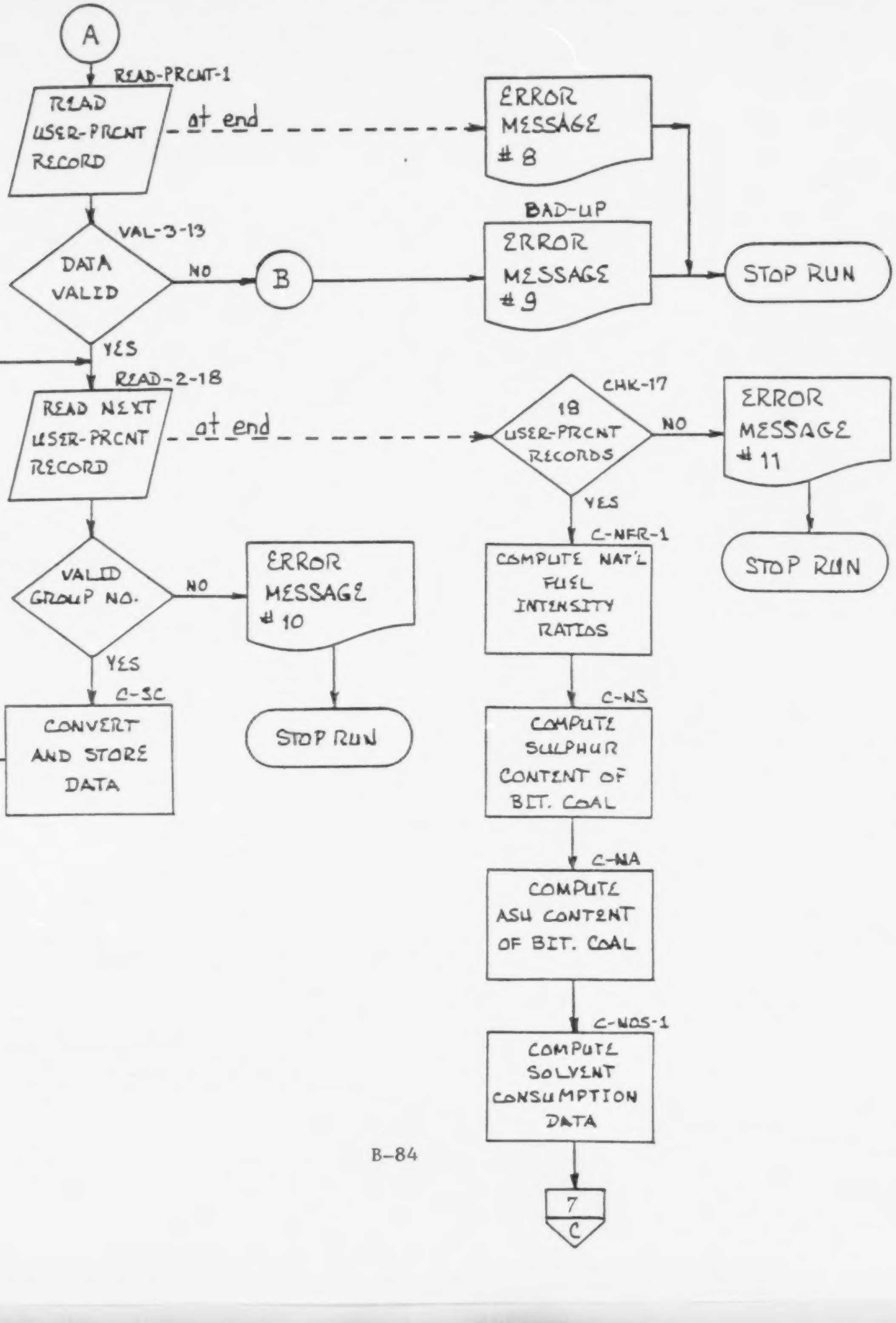
1. Commercial Natural Gas Consumption.
2. Commercial Anthracite and Bituminous Coal Consumption.
3. Commercial Residual and Distillate Oil Consumption.
4. Bituminous Sulphur and Ash Content.

When PASS-FOUR has completed all the calculations for an input county record, it writes out CARDS 1 through 4 to file NEDS-ATRAN and writes all county allocation results to a formatted county report. Results not computed by PASS-FOUR are picked up from an internal table where they were stored as computed by PASS-ONE through PASS-THREE. After these stored results are used to create the output file and report, PASS-FOUR clears the internal table of all data for the current county.

When PASS-FOUR has been executed for all counties within the state, control is returned to the FOUR-PASSES routine. FOUR-PASSES completes all processing for a state by formatting state totals that were accumulated by PASS-ONE through PASS-FOUR and writing these state totals to the output report. The internal table of state totals is cleared to zeroes and control is returned to program NE099's mainline routine.

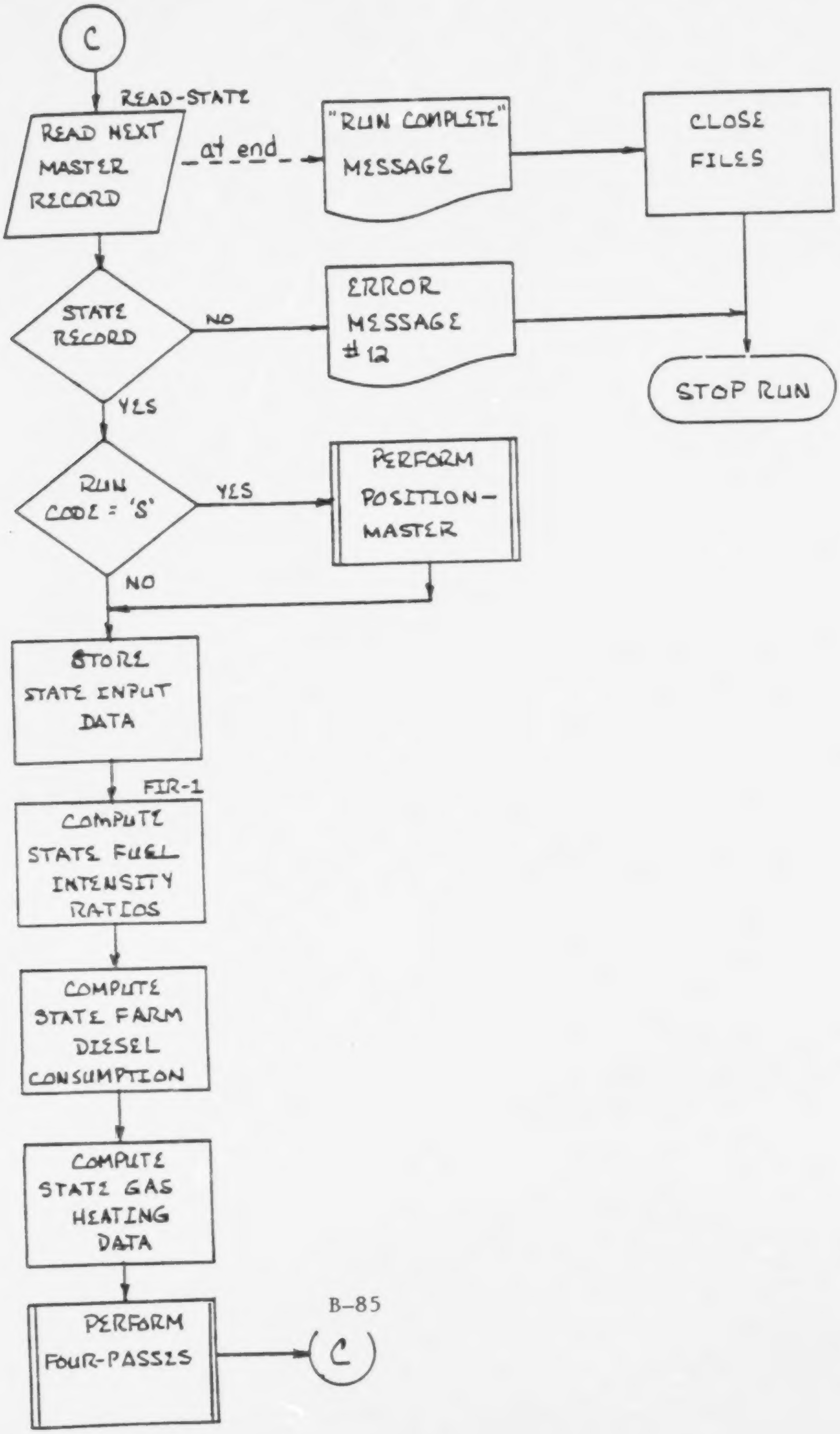
Program NE099 then positions file NEDS-AFC-MST at the beginning of data for the next state to be processed and returns control to the FOUR-PASSES routine. When all states have been processed for an annual national run, or all selected states have been processed for a special run, program processing is terminated.


START
READ PARAMETER CARD
at end
ERROR MESSAGE #1
BAD-PARAM
DATA VALID
NO
ERROR MESSAGE #2
STOP RUN
YES
READ-NAT
READ NATIONAL MASTER RECORD
at end
ERROR MESSAGE #3
STORE NAT'L. INPUT DATA
READ RU-MI-NDX RECORD
at end
ERROR MESSAGE #4
VAL-RU-MI
DATA VALID
YES
READ-FHA-MILES
READ FHA-MILES RECORD
VAL-FHA
DATA VALID
YES
6
A
NO
BAD-RU
ERROR MESSAGE #5
ERROR MESSAGE #6
NO
BAD-FHA
ERROR MESSAGE #7
STOP RUN

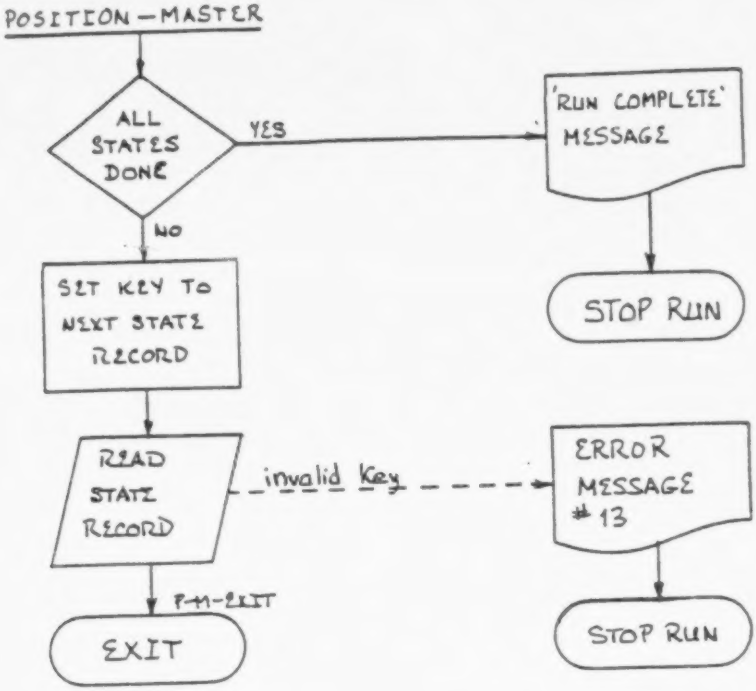


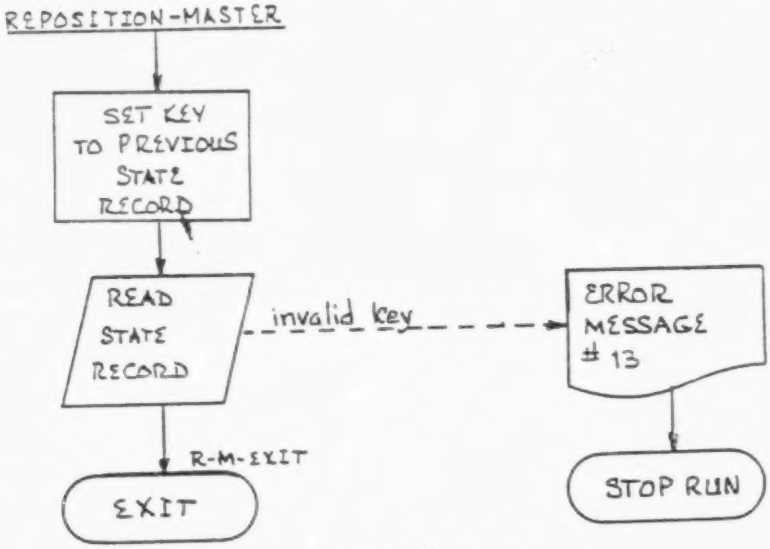
A
READ-PRCNT-1
READ USER-PRCNT RECORD
at end
ERROR MESSAGE # 8
VAL-3-13
DATA VALID
NO
B
BAD-UP
ERROR MESSAGE # 9
STOP RUN
YES
READ-2-18
READ NEXT USER-PRCNT RECORD
at end
CHK-17
18 USER-PRCNT RECORDS
NO
ERROR MESSAGE # 11
STOP RUN
YES
C-NFR-1
COMPUTE NAT'L FUEL INTENSITY RATIOS
VALID GROUP NO.
NO
ERROR MESSAGE # 10
STOP RUN
YES
C-SC
CONVERT AND STORE DATA
C-NS
COMPUTE SULPHUR CONTENT OF BIT. COAL
C-NA
COMPUTE ASH CONTENT OF BIT. COAL
C-NOS-1
COMPUTE SOLVENT CONSUMPTION DATA
7
C

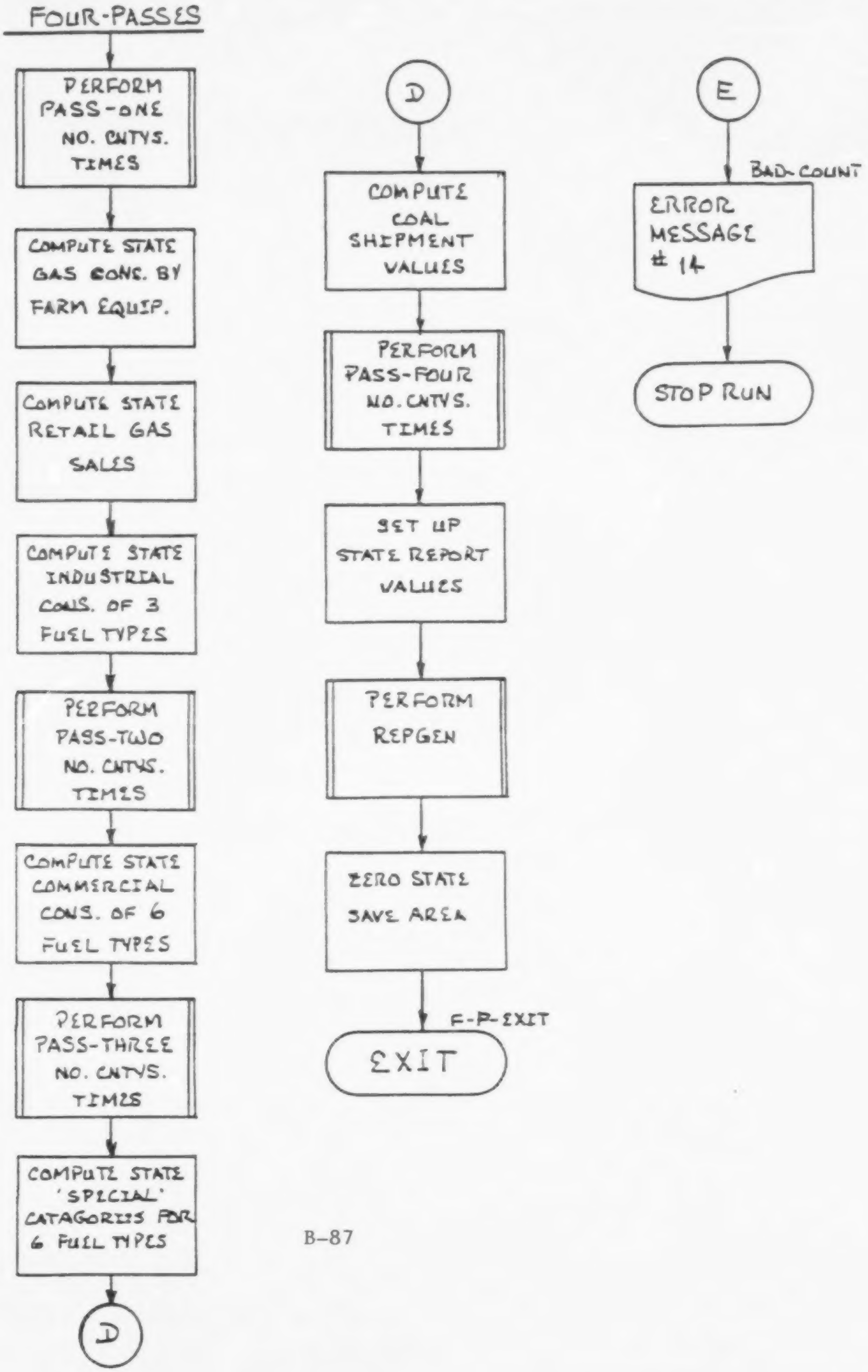
AEROS SOFTWARE DOCUMENTATION	COMPONENT NAME: NE099 SECTION: Detailed Program Description	SECTION 6 PAGE 7 DATE 3/02/79


C
READ-STATE
READ NEXT MASTER RECORD
at end
"RUN COMPLETE" MESSAGE
CLOSE FILES
STATE RECORD
NO
ERROR MESSAGE #12
STOP RUN
YES
RUN CODE = 'S'
YES
PERFORM POSITION-MASTER
NO
STORE STATE INPUT DATA
FIR-1
COMPUTE STATE FUEL INTENSITY RATIOS
COMPUTE STATE FARM DIESEL CONSUMPTION
COMPUTE STATE GAS HEATING DATA
PERFORM FOUR-PASSES
C

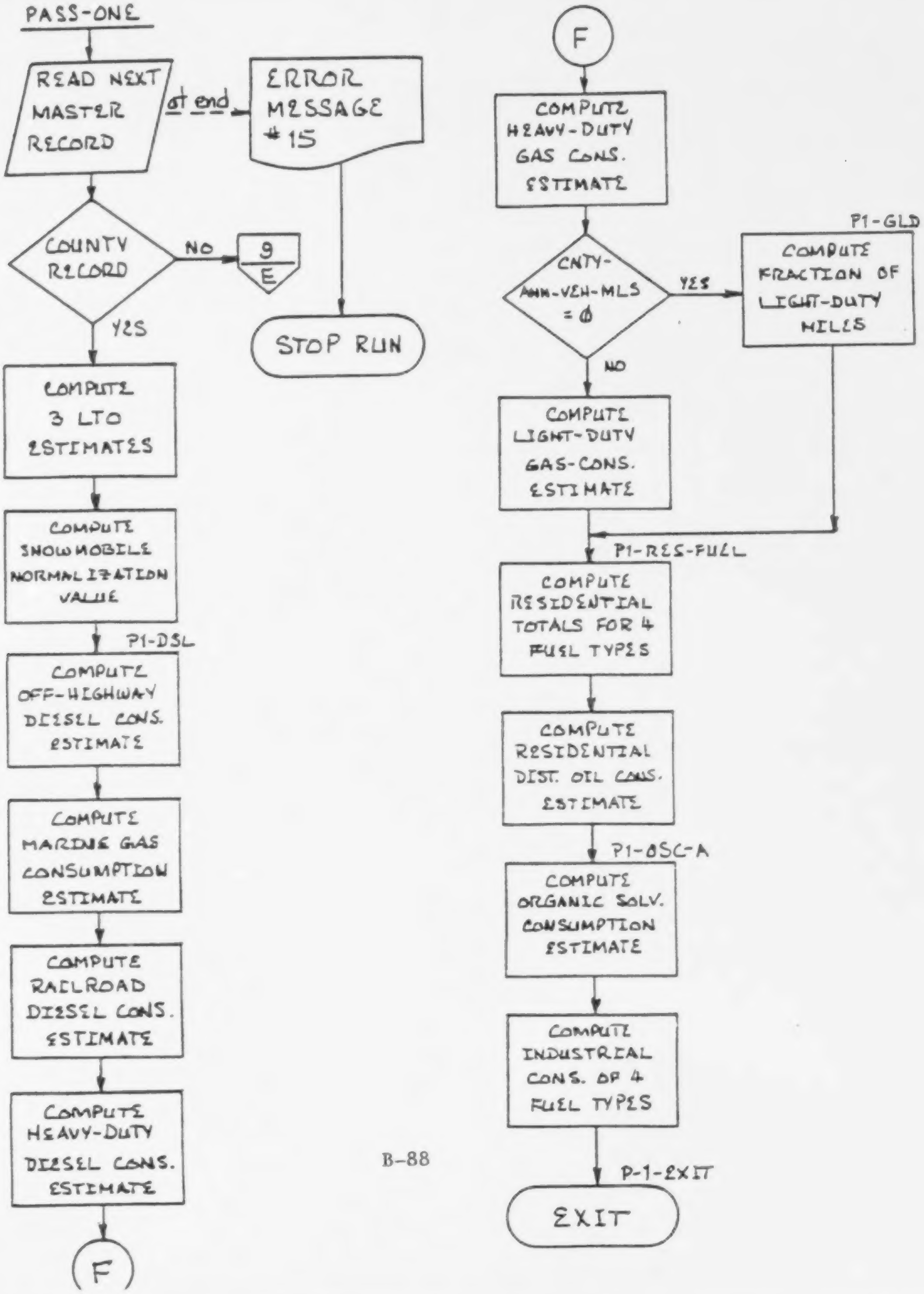
AEROS SOFTWARE	**COMPONENT NAME:** NE099	**SECTION** 6 **PAGE** [illegible]
DOCUMENTATION	**SECTION:** Detailed Program Description	**DATE** 3/02/79

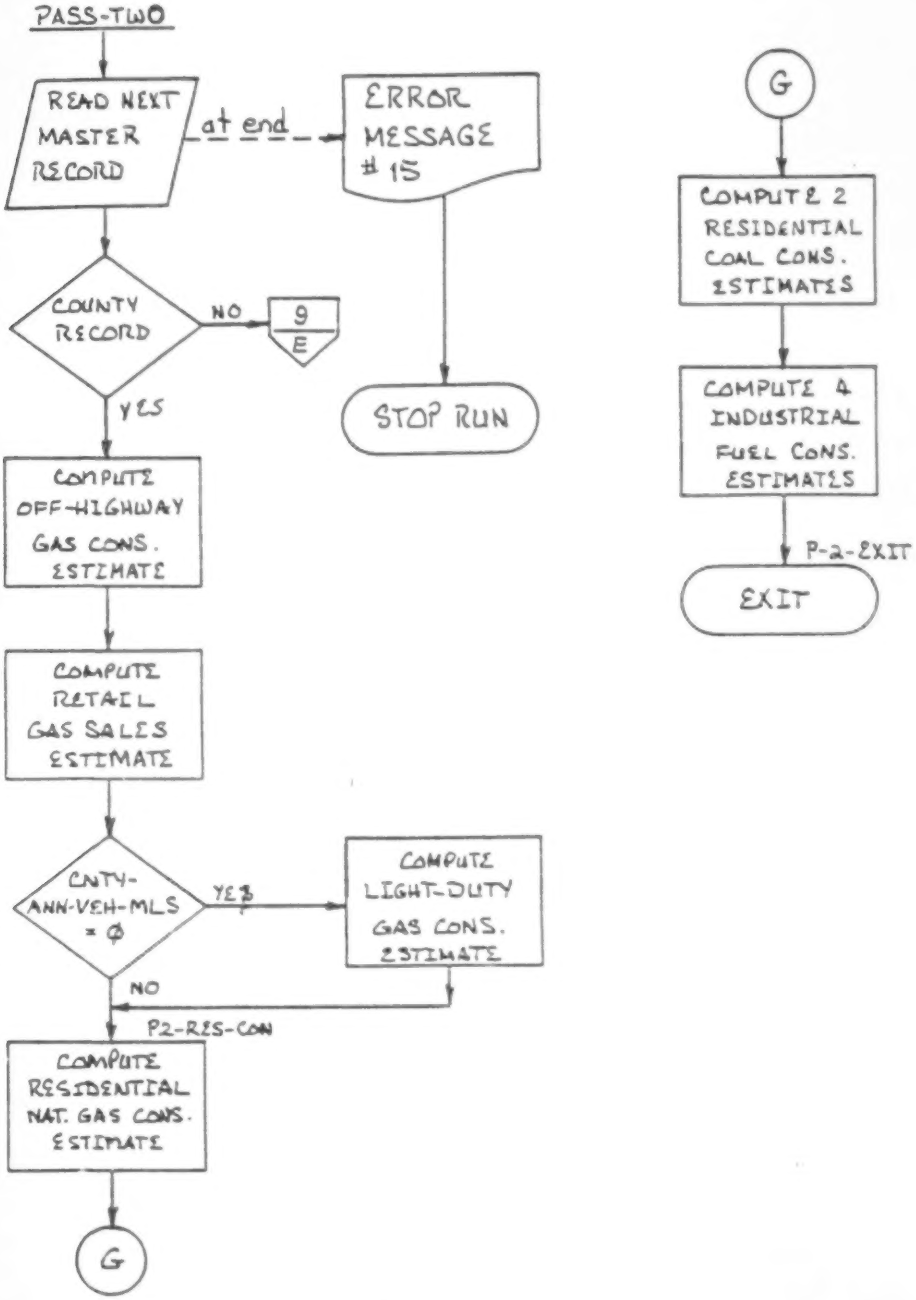

POSITION-MASTER
ALL STATES DONE
YES
NO
'RUN COMPLETE' MESSAGE
STOP RUN
SET KEY TO NEXT STATE RECORD
READ STATE RECORD
invalid Key
ERROR MESSAGE # 13
P-M-EXIT
EXIT
STOP RUN

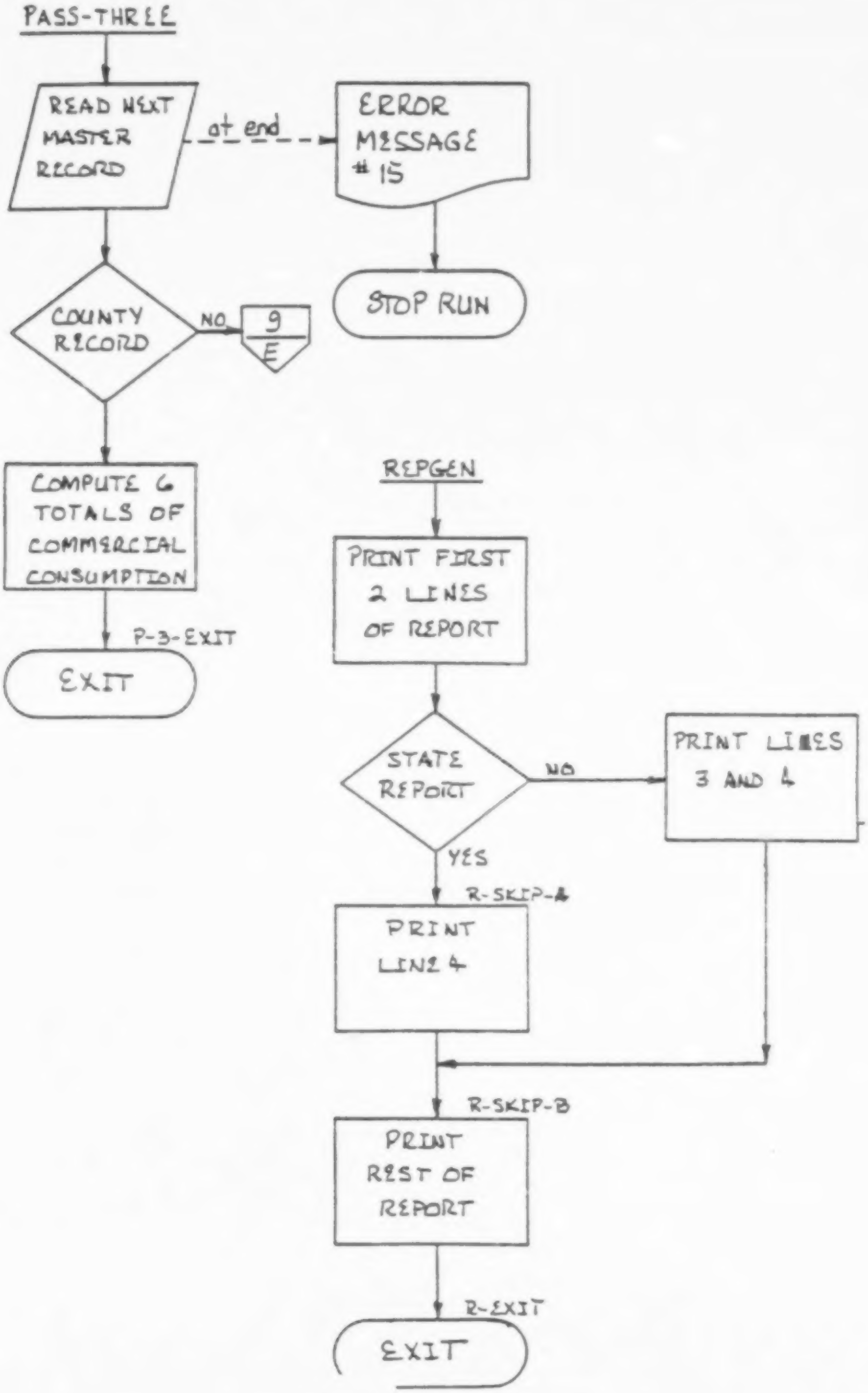

REPOSITION-MASTER
SET KEY TO PREVIOUS STATE RECORD
READ STATE RECORD
invalid key
ERROR MESSAGE # 13
R-M-EXIT
EXIT
STOP RUN



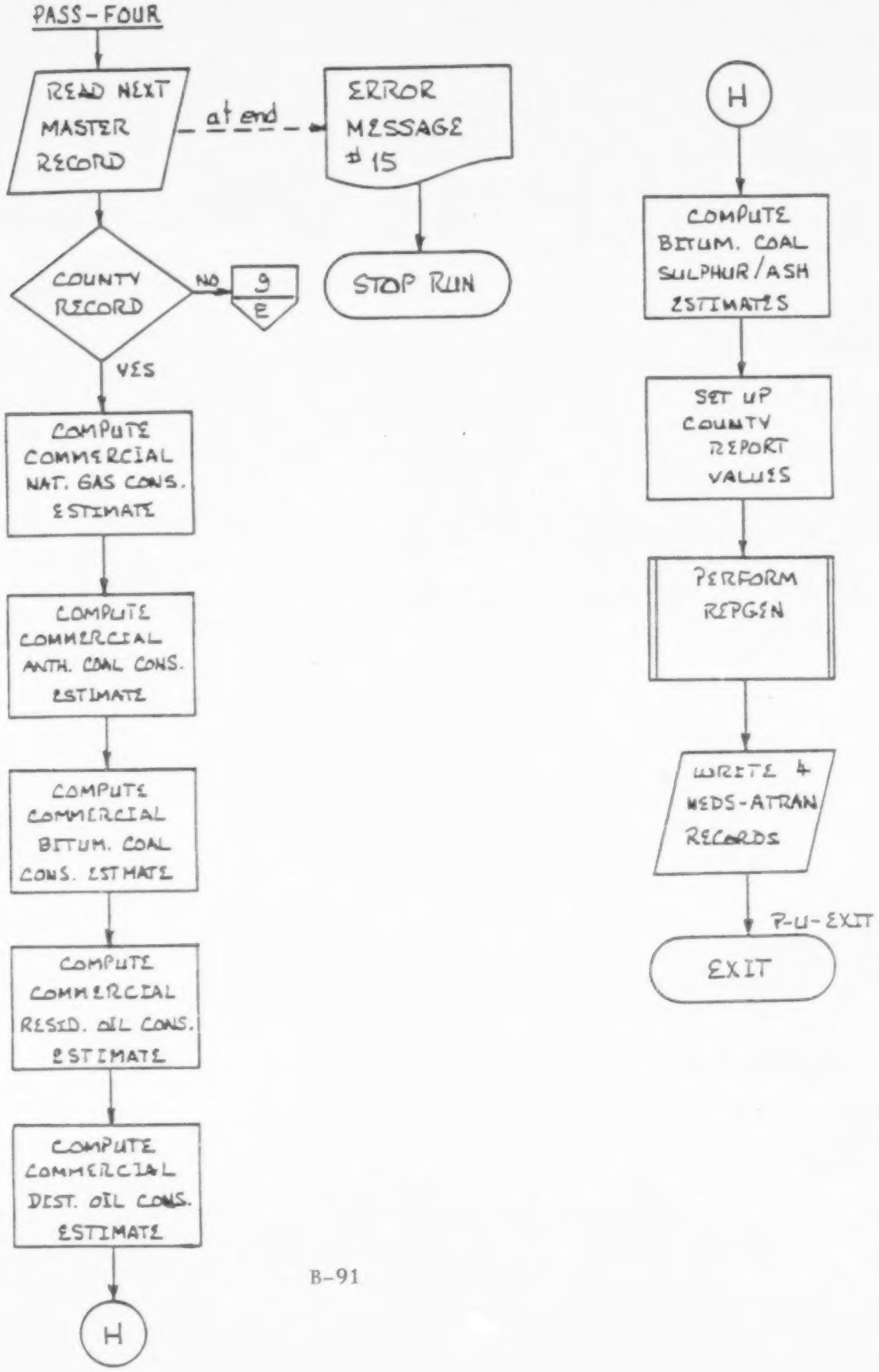
FOUR-PASSES
PERFORM PASS-ONE NO. CNTYS. TIMES
COMPUTE STATE GAS CONS. BY FARM EQUIP.
COMPUTE STATE RETAIL GAS SALES
COMPUTE STATE INDUSTRIAL CONS. OF 3 FUEL TYPES
PERFORM PASS-TWO NO. CNTYS. TIMES
COMPUTE STATE COMMERCIAL CONS. OF 6 FUEL TYPES
PERFORM PASS-THREE NO. CNTYS. TIMES
COMPUTE STATE 'SPECIAL' CATAGORIES FOR 6 FUEL TYPES
D
D
COMPUTE COAL SHIPMENT VALUES
PERFORM PASS-FOUR NO. CNTYS. TIMES
SET UP STATE REPORT VALUES
PERFORM REPGEN
ZERO STATE SAVE AREA
F-P-EXIT
EXIT
E
BAD-COUNT
ERROR MESSAGE # 14
STOP RUN


PASS-ONE
READ NEXT MASTER RECORD
at end
ERROR MESSAGE #15
STOP RUN
COUNTY RECORD
NO
9
E
YES
COMPUTE 3 LTO ESTIMATES
COMPUTE SNOWMOBILE NORMALIZATION VALUE
P1-DSL
COMPUTE OFF-HIGHWAY DIESEL CONS. ESTIMATE
COMPUTE MARINE GAS CONSUMPTION ESTIMATE
COMPUTE RAILROAD DIESEL CONS. ESTIMATE
COMPUTE HEAVY-DUTY DIESEL CONS. ESTIMATE
F
F
COMPUTE HEAVY-DUTY GAS CONS. ESTIMATE
CNTY-ANN-VEH-MLS = 0
YES
P1-GLD
COMPUTE FRACTION OF LIGHT-DUTY MILES
NO
COMPUTE LIGHT-DUTY GAS-CONS. ESTIMATE
P1-RES-FUEL
COMPUTE RESIDENTIAL TOTALS FOR 4 FUEL TYPES
COMPUTE RESIDENTIAL DIST. OIL CONS. ESTIMATE
P1-OSC-A
COMPUTE ORGANIC SOLV. CONSUMPTION ESTIMATE
COMPUTE INDUSTRIAL CONS. OF 4 FUEL TYPES
P-1-EXIT
EXIT


PASS-TWO
READ NEXT MASTER RECORD
at end
ERROR MESSAGE # 15
STOP RUN
COUNTY RECORD
NO
9
E
YES
COMPUTE OFF-HIGHWAY GAS CONS. ESTIMATE
COMPUTE RETAIL GAS SALES ESTIMATE
CNTY-ANN-VEH-MLS = 0
YES
COMPUTE LIGHT-DUTY GAS CONS. ESTIMATE
NO
P2-RES-CON
COMPUTE RESIDENTIAL NAT. GAS CONS. ESTIMATE
G
G
COMPUTE 2 RESIDENTIAL COAL CONS. ESTIMATES
COMPUTE 4 INDUSTRIAL FUEL CONS. ESTIMATES
P-2-EXIT
EXIT



PASS-THREE
READ NEXT MASTER RECORD
at end
ERROR MESSAGE #15
STOP RUN
COUNTY RECORD
NO
9
E
COMPUTE 6 TOTALS OF COMMERCIAL CONSUMPTION
P-3-EXIT
EXIT
REPGEN
PRINT FIRST 2 LINES OF REPORT
STATE REPORT
NO
PRINT LINES 3 AND 4
YES
R-SKIP-A
PRINT LINE 4
R-SKIP-B
PRINT REST OF REPORT
R-EXIT
EXIT



PASS-FOUR
READ NEXT MASTER RECORD
at end
ERROR MESSAGE #15
STOP RUN
COUNTY RECORD
NO
9
E
YES
COMPUTE COMMERCIAL NAT. GAS CONS. ESTIMATE
COMPUTE COMMERCIAL ANTH. COAL CONS. ESTIMATE
COMPUTE COMMERCIAL BITUM. COAL CONS. ESTMATE
COMPUTE COMMERCIAL RESID. OIL CONS. ESTIMATE
COMPUTE COMMERCIAL DEST. OIL CONS. ESTIMATE
H
H
COMPUTE BITUM. COAL SULPHUR/ASH ESTIMATES
SET UP COUNTY REPORT VALUES
PERFORM REPGEN
WRITE 4 NEDS-ATRAN RECORDS
P-4-EXIT
EXIT

Calculations

Program NE099:

Program NE099, the major calculation program in the AFCA system, computes county-wide estimates of fuel consumption using national, state, and county data items which have been collected by previous AFCA programs and stored on file NEDS-AFC-MST. Thirty-one estimated totals are produced by program NE099 for each SAROAD county and output to NEDS Area Source Cards 1 through 4. The calculations executed to produce these estimates are specified below in twelve general categories.

I Aircraft Landing and Take-Off Cycles (3 estimates)

County landing and take-off cycles are calculated separately for three aircraft categories:

1) Civil (general) Aircraft LTO Cycles
2) Commercial Aircraft LTO Cycles
3) Military Aircraft LTO Cycles

For counties with FAA-regulated airports and/or military airports (at least one of the following three fields on CNTY-AFC-REC is nonblank: CNTY-C-A-OPR, CNTY-G-A-OPR, or CNTY-M-A-OPR), LTO's are derived directly from reported operations using the formulas:

$$LTO_i = \frac{0.5 \times O_i}{10} \quad \underline{\text{and}} \quad LTO_3 = \frac{0.5 \times O_3}{100}$$

where:

LTO_i = County LTO's for aircraft category i (i=1 for commercial aircraft; i=2 for civil aircraft)

LTO_3 = County LTO's for military aircraft.

O_i = Total operations in county for aircraft category i (on CNTY-AFC-REC)

O_3 = Total military aircraft operations in County (CNTY-M-A-OPR on CNTY-AFC-REC)

For counties with no FAA-regulated airports or military airports, all operations in the county are assumed to involve civil aircraft only. The number of LTO's for civil aircraft (LTO_2) is calculated from the county aircraft registrations (CNTY-AIRCRAFT-REG on CNTY-AFC-REC) using the formula:

$$LTO_2 = \frac{250 * N}{10}$$

where:

N = County aircraft registrations (on CNTY-AFC-REC)

II. Consumption of Gasoline and Diesel Fuel by Off-Highway Sources (2 estimates)

Off-highway sources have been divided into six categories. Total off-highway consumption of gasoline and diesel fuel is the sum of the consumption estimates of the individual categories as follows:

1) Off-Highway Consumption of Gasoline (G) is computed using the formula:

$$G = \sum_{j=1}^{6} F_j$$

where:

F_j = Gasoline consumption by off-highway category j (j=1 for farm equipment; j=2 for construction equipment; j=3 for industrial equipment; j=4 for motorcycles; j=5 for lawn and garden equipment; j=6 for snowmobiles)

The formulas used to compute values for F_1 through F_6 follow:

(A) County Gasoline Consumption by Farm Equipment (F_1):

$$F_1 = FS_1 * \frac{TC}{TS}$$

where:

FS_1 = State gasoline consumption by farm equipment (computed with another formula given below)

TC = County tractor population (CNTY-TRCTR-POP on CNTY-AFC-REC)

TS = State tractor population (SFE-TRCTRS on STE-AFC-REC)

The formula used to compute FS_1 is:

$$FS_1 = \frac{\sum_{k=1}^{5} f_k*N_k*A_k*FR_k}{1000}$$

where:

f_k = Fraction of farm equipment in subcategory k that is powered by gasoline (k=1 for tractors, FE-TRCTRS-GAS on NTL-AFC-REC; k=2 for combines, FE-CMBINS-GAS on NTL-AFC-REC; k=3 for balers, FE-BALERS-GAS on NTL-AFC-REC; k=4 for harvesters, FE-HRVSTRS-GAS on NTL-AFC-REC; k=5 for large general purpose engines, FE-G-P-GAS on NTL-AFC-REC)

N_k = State population of farm equipment in subcategory k (N_1 is SFE-TRCTRS on STE-AFC-REC; N_2 is SFE-CMBINS on STE-AFC-REC; N_3 is SFE-BALRS on STE-AFC-REC; N_4 is SFE-HRVSTRS on STE-AFC-REC; N_5 is estimated using the formula described below)

A_k = Average annual usage (hours/year) of farm equipment in subcategory k using gasoline (A_1 is FEO-GAS-TRCTRS on NTL-AFC-REC; A_2 is FEO-CMBINS on NTL-AFC-REC; A_3 is FEO-BALERS on NTL-AFC-REC; A_4 is FEO-HRVSTRS on NTL-AFC-REC; A_5 is FEO-GEN-PURP on NTL-AFC-REC)

FR_k = Average consumption (gals./hour) of gasoline per unit of equipment in subcategory k (FR_1 is ACR-GAS-TRCTRS on NTL-AFC-REC; FR_2 is ACR-GAS-CMBIN on NTL-AFC-REC; FR_3 is ACR-GAS-BALER on NTL-AFC-REC; FR_4 is ACR-GAS-HRVSTRS; FR_5 is ACR-GAS-G-PURP)

The formula used to compute state population of large general purpose farm engines (N_5) is:

$$N_5 = 0.30*TS*\left(\frac{SIF}{SF}\right) + 0.05*TS*\left(\frac{SF-SIF}{SF}\right)$$

where:

TS = State tractor population (SFE-TRCTRS on STE-AFC-REC)

SF = Number of farms in state (STE-FRMS-GT-2500 on STE-AFC-REC)

SIF = Number of farms in state in Irrigated Areas (STE-IRGAT-FRMS on STE-AFC-REC)

(B) County Gasoline Consumption by Construction Equipment (F_2):

$$F_2 = NCG*\left(\frac{SCE}{NCE}\right)*\left(\frac{CP}{SP}\right)$$

where:

NCG = National gasoline consumption by construction equipment (OH-G-CONS-ENG on NTL-AFC-REC)

SCE = State employment in heavy construction (HVY-CNSTRTN on STE-AFC-REC)

NCE = National employment in heavy construction (ET-HVY-CONS on NTL-AFC-REC)

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

SP = Current state population (STE-CRNT-POP on STE-AFC-REC)

(C) County Gasoline Consumption by Industrial Equipment (F_3):

$$F_3 = NIG * \left(\frac{CMF+CME+CWE}{NMF+NME+NWE}\right)$$

where:

NIG = National gasoline consumption by industrial equipment (OH-G-IND-ENG on NTL-AFC-REC)

CMF = Total county employment in manufacturing (CBP-SIC-19 on CNTY-AFC-REC)

CME = Total county employment in mining (CBP-SIC-10 on CNTY-AFC-REC)

CWE = Total county employment in wholesale trade (CBP-SIC-50 on CNTY-AFC-REC)

NMF = Total national employment in manufacturing (SC-TOT-MFG-EMP on NTL-AFC-REC)

NME = Total national employment in mining (ET-MNG on NTL-AFC-REC)

NWE = Total national employment in wholesale trade (ET-WHLS-TRD on NTL-AFC-REC)

(D) County Gasoline Consumption by Motorcycles (F_4):

$$F_4 = \frac{\frac{CP}{SP} * \left(SM * \frac{f_1 u_1 + f_2 u_2}{MFR}\right)}{1000}$$

where:

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

SP = Current state population (STE-CRNT-POP on STE-AFC-REC)

SM = State motorcycle population (SP-MOTCYCL on STE-AFC-REC)

MFR = Motorcycle fuel consumption rate (mi./gal.; NTL-MOT-G-CONS-RATE on NTL-AFC-REC)

f_1 = Fraction of motorcycles that are off-road (one of nine data items within NTL-PCT-OFF-RD-MOT field of NTL-AFC-REC, depending on which census region county is in)

u_1 = Average usage (mi./yr.) of off-road motorcycles (AMY-OFF-RD-MOT on NTL-AFC-REC)

f_2 = Fraction of motorcycles that are combination (one of nine data items within NTL-PCT-COMB-MOT field of NTL-AFC-REC, depending on which census region county is in)

u_2 = Average off-road usage (mi./yr.) by combination motorcycles (AMY-O-R-COM-MOT on NTL-AFC-REC)

(E) County Gasoline Consumption by Lawn and Garden Equipment (F_5):

$$F_5 = NLG* \left(\frac{CSU}{NSU}\right) * \left(\frac{CFF*3174}{NFF}\right) + \left[K*NSG*\left(\frac{CP}{SZP}\right) * \left(\frac{CS*3174}{SZS}\right)\right]$$

where:

NLG = National gasoline consumption by lawn and garden equipment other than snowthrowers (OH-G-L-G-ENG on NTL-AFC-REC)

CSU = Number of dwelling units in single unit structures in county (CNTY-NO-S-U-STR on CNTY-AFC-REC)

NSU = Number of dwelling units in single unit structures in nation (NTL-NO-DWLG-UNTS on NTL-AFC-REC)

CFF = Number of freeze free days in county (CNTY-F-F-DAYS on CNTY-AFC-REC)

NFF = Number of freeze-free days in nation (NTL-NO-FRZ-FRE-DAYS on NTL-AFC-REC)

NSG = National gasoline consumption by snowthrowers (OH-G-SNWTHROWRS on NTL-AFC-REC)

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

SZP = Snow-zone population (NTL-SNW-ZN-POP on NTL-AFC-REC)

CS = County snowfall (CNTY-ANN-SNOW on CNTY-AFC-REC)

SZS - Snow-zone snowfall (NTL-SNW-ZN-SNFL on NTL-AFC-REC)

$$K \begin{cases} = 0 \text{ if } CS \leq 30 \text{ inches} \\ = 1 \text{ if } CS > 30 \text{ inches} \end{cases}$$

(F) County Gasoline Consumption by Snowmobiles (F_6):

$$F_6 = NGS * \left(\frac{CSM}{NSM}\right)$$

where:

NGS = National gasoline consumption by snowmobiles (OH-G-SNWMBLS on NTL-AFC-REC)

CSM = County snowmobile population (computed with another formula given below)

NSM = National snowmobile population (NTL-SNWMBL-POP on NTL-AFC-REC)

The formula used to compute CSM is:

$$CSM = \frac{f}{\sum_{c=1}^{n} f_c} * SSM$$

where:

f_c = Fraction of state's snowmobiles that are located in the county (estimated using a formula described below)
n = Number of counties in state (STE-NO-CNTYS on CNTY-AFC-REC)
SSM = State snowmobile population (SP-SNWMBL on STE-AFC-REC)

The formula used to compute the fraction of the state's snowmobiles that are located in the county (f) is determined by the county's population density:

- For counties with population densities (CNTY-POP-DENS on CNTY-AFC-REC) of less than 1000 per square mile, the formula is:

$$f = 1.56 * \left(\frac{CP}{SP}\right) + \left[0.0321\left(\frac{CS}{CCS}\right)\right] - 0.0234$$

where:

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

SP = Current state population (STE-CRNT-POP on STE-AFC-REC)

CS = County snowfall (CNTY-ANN-SNOW on CNTY-AFC-REC)

CCS = Snowfall in state's centroid county (STE-ANN-SNWFL on STE-AFC-REC)

- For counties with population densities that are greater than or equal to 1000 per square mile, the formula is:

$$f = \left[X*\left(\frac{CP}{SP}\right)\right] * \left[1.5-(0.0005*CPD)\right]$$

where:

CP = Current county population

SP = Current state population

CPD = County population density (CNTY-POP-DENS on CNTY-AFC-REC)

$$X \begin{cases} = 0 \text{ if } CPD > 3000 \\ = 1 \text{ if } 3000 \geq CPD \geq 1000 \end{cases}$$

2) Off-Highway Consumption of Diesel Fuel (DF) is computed using the formula:

$$DF = \sum_{j=1}^{3} E_j$$

where:

E_j = Diesel fuel consumption by off-highway category j (see Section II. 1. above for definitions of j: 1-3)

The formulas used to compute values for E_1 through E_3 follow:

(A) County Diesel Fuel Consumption by Farm Equipment (E_1):

$$E_1 = DFS_1 * \frac{TC}{TS}$$

where:

DFS_1 = State diesel fuel consumption by farm equipment (computed with another formula given below)

TC = County tractor population (CNTY-TRCTR-POP on CNTY-AFC-REC)

TS = State tractor population (SFE-TRCTRS on STE-AFC-REC)

The formula used to compute DFS_1 is:

$$DFS_1 = \frac{\sum_{k=1}^{5} fd_k * N_k * AD_k * FRD_k}{10,000}$$

where:

fd_k = Fraction of farm equipment in subcategory k that is powered by diesel fuel

o fd_1 = Fraction of tractors powered by diesel fuel (FE-TRCTRS-DSL on NTL-AFC-REC)

- fd_2 = Fraction of combines powered by diesel fuel (100-f_2; f_2 is FE-COMBINS-GAS on NTL-AFC-REC)
- fd_3 = Fraction of balers powered by diesel fuel (100-f_3; f_3 is FE-BALERS-GAS on NTL-AFC-REC)
- fd_4 = Fraction of harvesters powered by diesel fuel (100-f_4; f_4 is FE-HRVSTRS-GAS on NTL-AFC-REC)
- fd_5 = Fraction of general purpose engines powered by diesel fuel (100-f_5; f_5 is FE-G-P-GAS on NTL-AFC-REC)

N_k = State population of farm equipment in subcategory k; see specification of State Farm Equipment Gasoline Consumption formula above (Section II. 1. A.) for definitions of N_1 through N_5

AD_k = Average annual usage (hours/year) of farm equipment in subcategory k using diesel fuel (AD_1 is FEO-DSL-TRCTRS on NTL-AFC-REC; AD_2 is FEO-COMBINS on NTL-AFC-REC; AD_3 is FEO-BALERS; AD_4 is FEO-HRVSTRS; AD_5 is FEO-GEN-PURP)

FRD_k = Average consumption (gals./hour) of diesel fuel per unit of equipment in subcategory k (FRD_1 is ACR-DSL-TRCTR on NTL-AFC-REC; FRD_2 is ACR-DSL-CMBIN on NTL-AFC-REC; FRD_3 is ACR-DSL-BALER; FRD_4 is ACR-DSL-HRVSTR; FRD_5 is ACR-DSL-G-PURP)

(B) County Diesel Fuel Consumption by Construction Equipment (E_2):

$$E_2 = \frac{NCD}{10} * \left(\frac{SCE}{NCE}\right) * \left(\frac{CP}{SP}\right)$$

where:

NCD = National diesel fuel consumption by construction equipment (OH-D-CONS-ENG on NTL-AFC-REC)

SCE = State employment in heavy construction (HVY-CNSTRTN on STE-AFC-REC)

NCE = National Employment in heavy construction (ET-HVY-CONS on NTL-AFC-REC)

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

SP = Current state population (STE-CRNT-POP on STE-AFC-REC)

(C) County Diesel Fuel Consumption by Industrial Equipment (E_3):

$$E_3 = \frac{NID}{10} * \left(\frac{CMF+CME+CWE}{NMF+NME+NWE}\right)$$

where:

NID = National diesel fuel consumption by industrial equipment (OH-D-IND-ENG on NTL-AFC-REC)

See specification of County Industrial Equipment Gasoline Consumption formula above (Section II. 1. C.) for definitions of CMF, CME, CWE, NMF, NME, and NWE.

III. Retail Gasoline Sales (1 estimate)

Some states report retail gasoline sales (gallons) by county For these states the reported county figures are used directly. (If the CNTY-FLG field on CNTY-AFC-REC is blank, then the CNTY-RET-GS-SLS field contains gallons of retail gasoline sold in the county, and that figure is output to NEDS Area Source Card 4.)

For states that do not report county retail gasoline sales, an estimate (CGS) is derived using the formula:

$$CGS = \frac{SHG * \left(\frac{CGR}{SGR}\right) + \sum_{j=1}^{3} F_j + \left[SAG*\left(\frac{CLT}{SLT}\right)\right]}{100}$$

where:

SHG = State retail sales of gasoline for highway and marine use (computed with another formula given below)

CGR = Gross receipts of gasoline service stations in county (CNTY-RET-GS-SLS on CNTY-AFC-REC)

SGR = Gross receipts of gasoline service stations in state (STE-TOT-GRS-RVN on STE-AFC-REC)

F_j = County gasoline consumption by off-highway category j (use values for F_1, F_2 and F_3 computed with equations given in Section II. 1. A. through Section II. 1. C. above)

SAG = State aviation gasoline consumption (GAS-AVATN on STE-AFC-REC)

CLT = Total LTO cycles in county for military, civil, and commercial aircraft (sum of LTO_1, LTO_2, and LTO_3 computed with equations given in Section I. above)

SLT = Total LTO cycles in state for 3 aircraft categories (STE-NO-ARCRFT-OPER on STE-AFC-REC)

The formula used to compute SHG is:

$$SHG = (TSO + TSH) - (SGC + SGI + SGF + SAG)$$

where:

TSO = Total state off-highway gasoline consumption (STE-TOT-O-H-G-CONS on STE-AFC-REC)

TSH = Total state highway gasoline consumption (HFC-GAS on STE-AFC-REC)

SGC = Reported state gasoline consumption by construction equipment (GAS-CNSTR-EQ on STE-AFC-REC)

SGI = Reported state commercial-industrial gasoline consumption (GAS-COML-IND on STE-AFC-REC)

SGF = Reported state agricultural gasoline consumption (GAS-AGRCLT on STE-AFC-REC)

SAG = State aviation gasoline consumption (GAS-AVATN on STE-AFC-REC)

IV. Consumption of Gasoline by Marine Vessels (1 estimate)

County consumption of gasoline by Marine Vessels (MVG) is computed using the formula:

$$MVG = \left[\frac{CIW+(f_s*CC)}{SIW+(f_s*SC)}\right] * \left[\frac{10*CWM(SIB*IFC+SOB*OFC)}{1000}\right]$$

where:

CIW = County inland water area (CNTY-IN-WIR-AREA on CNTY-AFC-REC)

f_s = State factor for converting coastline to inland water area (STE-CSTLN-CONV-FCTR on STE-AFC-REC)

CC = County Coastline (CNTY-CSTLN on CNTY-AFC-REC)

SIW = State inland water area (STE-INLND-WTR-AREA on STE-AFC-REC)

SC = State coastline (STE-CSTLN-MI on STE-AFC-REC)

CWM = Number of "warm" months in county (CNTY-WRM-MOS on CNTY-AFC-REC)

SIB = State inboard boat population (SP-INBD-BOT on STE-AFC-REC)

IFC = Average gasoline consumption rate (gals./hr.) of inboard boats (GCR-INBD-MOTR on NTL-AFC-REC)

SOB = State outboard boat population (SP-OUTBD-BOT on STE-AFC-REC)

OFC = Average gasoline consumption rate (gal./hr.) of outboard boats (GCR-OUTBD-MOTR on NTL-AFC-REC)

V. Consumption of Diesel Fuel by Railroads (1 estimate)

County Consumption of diesel fuel by Railroads (RRD) is computed using the formula:

$$RRD = (SRD*4.2) * \left(\frac{CP}{SP}\right)$$

where:

SRD = State consumption of diesel fuel by railroads (STE-RR-DSL on STE-AFC-REC)

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

SP = Current state population (STE-CRNT-POP on STE-AFC-REC)

VI. Consumption of Gasoline and Diesel Fuel by Highway Vehicles (3 estimates)

County fuel consumption by highway vehicles is calculated separately for three different categories:

1) County diesel fuel consumption by Heavy-Duty Vehicles (DHD) is calculated by a two step process.

A) First calculate the county's heavy duty diesel Vehicle VMT (HDDV-VMT). HDDV-VMT is calculated using the formula:

$$\text{HDDV-VMT} = \left(\frac{CT}{ST} * \text{HDDV-SVMT}\right) + \left(\frac{CM}{RM} * \text{HDDV-LVMT}\right)$$

where:

CT = Number of trucks in county > 26,000 lbs (TRKS-GT-26000 on CNTY-AFC-REC)

ST = Number of trucks in state > 26,000 lbs (TR-GT-26000 on STE-AFC-REC)

HDDV-SVMT = HDDV vehicle miles traveled within the state of registration (TIUS-SHORT-RANGE-VMT on TIUS-VMT-RECORD)

$\frac{CM}{RM}$ = Fraction of county mileage to national mileage (NN-FRACT on NN-RECORD)

HDDV-LVMT = National total of HDDV vehicle miles traveled outside of the state of registration (TIUS-LONG-RANGE-VMT on TIUS-VMT-RECORD when the TIUS state code = 99)

B) County diesel fuel consumption (DHD) is then computed from HDDV-VMT with the following formula:

$$\text{DHD} = \frac{\text{HDDV-VMT / HD-DSL-MPG}}{1000}$$

where:

HD-DSL-MPG = Average miles per gallon for HDDV (INDCTR-HD-DSL-MPG on IND-CARD)

2) County gasoline consumption by Heavy-Duty Vehicles (GHD) is calculated using the formula:

$$GHD = \left[\sum_{w=1}^{3} \frac{HDV_w * AMT_w}{MPG_w} \right] + \left[\left(\frac{CCP}{SCP} \right) * \left(\frac{SIB * GIB}{1000} \right) \right]$$

where:

HDV_w = Number of trucks in county in weight category w (w = 1 for trucks 6001-10,000 lbs., TRKS-6001-10000 on CNTY-AFC-REC; w = 2 for trucks 10,001-19500 lbs., TRKS-10001-19500 on CNTY-AFC-REC; w = 3 for trucks 19,501-26000 lbs., TRKS-19501-26000 on CNTY-AFC-REC).

AMT_w = Average miles/year traveled in state by trucks in weight category w (AMT_1 is AVG-6001-1000 on STE-AFC-REC; AMT_2 is AVG-10001-20000 on STE-AFC-REC; AMT_3 is AVG-26000).

MPG_w = Miles per gallon for trucks in weight category w (national data contained in element FHA-MILES of file NADB-CONTROL; MPG_1 is FHA-MILES-1; MPG_2 is FHA-MILES-2; MP_3 is FHA-MILES-3).

CCP = County population in most recent census year (CNTY-C-YR-POP on CNTY-AFC-REC).

SCP = State population in most recent census year (STE-CNS-YR-POP on STE-AFC-REC).

SIB = Number of institutional buses in state (NG-SCH-INST on STE-AFC-REC).

GIB = Average gasoline consumption (gal./yr) of institutional buses (NTL-SCH-BUS on NTL-AFC-REC).

SHB = State highway butane fuel consumption (HFC-SPD-FULS on STE-AFC-REC).

3) County gasoline consumption by Light-Duty Vehicles (GLD) is calculated using one of the following two formulas.

A) For states that report annual vehicle miles by county, the formula is:

$$GLD = \left[\left(\frac{CVM}{SVM} \right) * TSH \right] - GHD$$

where:

CVM = Annual vehicle miles traveled in county (CNTY-ANN-VEH-MLS on CNTY-AFC-REC).

SVM = Annual vehicle miles traveled in state (STE-ANN-VEH-MI on STE-AFC-REC).

TSH = Total state highway gasoline consumption (HFC-GAS on STE-AFC-REC).

GHD = County gasoline consumption by heavy-duty vehicles (computed with formula given in Section VI. 2. above).

B) For states that do not report annual vehicle miles by county (the CNTY-ANN-VEH-MLS field on CNTY-AFC-REC is blank), the formula is:

$$GLD = \left[\frac{(CRA + CLT) * i}{\sum_{c=1}^{n} (CRA_c + CLT_c) * i_c} * TSH \right] - GHD$$

where :

CRA = Number of automobiles registered in county (TOT-A-REG on CNTY-AFC-REC).

CLT = Number of trucks in county ≤ 6000 lbs. (TRKS-LTE-6000 on CNTY-AFC-REC)

i = Rural/urban miles per vehicle index for county (one of four data items on record in element RU-MI-NDX of file NADB-CONTROL depending on what percentage of county's population is rural)

n = number of counties in state STE-NO-CNTYS on STE-AFC-REC)

TSH = Total state highway gasoline consumption (HFC-GAS on STE-AFC-REC)

GHD = County gasoline consumption by heavy-duty vehicles (computed with formula given in Section VI. 2. above)

VII. Organic Solvent Consumption (1 estimate)

County organic solvent consumption (COS) is the sum of consumption of seventeen solvent types by 18 different solvent-user groups. The formula is:

$$COS = \sum_{s=1}^{17} \sum_{u=1}^{18} \frac{(CE_u - CPE_u)}{(NE_u - NPE_u)} * NOS_{su}$$

where:

CE_u = Number of individuals (employment or population) in county in solvent-user category u

(u=1 for current population, SC-CAT-1 on CNTY-AFC-REC;
u=2 for SIC 7535 employment, SC-CAT-2 on CNTY-AFC-REC;
u=3 for SIC 371 employment, SC-CAT-3 on CNTY-AFC-REC;
u=4 for SIC 25 employment, CBP-SIC-25 on CNTY-AFC-REC;
u=5 for SIC 34 employment, CBP-SIC-34 on CNTY-AFC-REC;
u=6 for employment in SIC's 35 and 36, SC-CAT-6 on CNTY-AFC-REC;
u=7 for SIC 26 employment, CBP-SIC-26 on CNTY-AFC-REC;
u=8 for employment in SIC's 243 and 244, SC-CAT-8 on CNTY-AFC-REC;
u=9 for non-auto transportation employment, SC-CAT-9 on CNTY-AFC-REC;
u=10 for SIC 36 employment, CBP-SIC-36 on CNTY-AFC-REC;

u=11 for total manufacturing employment, CBP-SIC-19 on CNTY-AFC-REC;
u=12 for employment in SIC 373, SC-CAT-12 on CNTY-AFC-REC;
u=13 for employment in degreasing trades, DG-CAT-13 on CNTY-AFC-REC;
u=14 for employment in solvent laundries, DC-CAT-14 on CNTY-AFC-REC;
u=15 for employment in printing trades, PP-CAT-15 on CNTY-AFC-REC;
u=16 for employment in SIC 30, CBP-SIC-30 on CNTY-AFC-REC;
u=17 for total manufacturing employment, CBP-SIC-19; and
u=18 for current population, SC-CAT-1)

CPE_u = Number of individuals in county in point source solvent-user category u

(CPE_1 is 0;
CPE_2 is PSE-SC-CAT-2 on CNTY-AFC-REC;
CPE_3 is PSE-SC-CAT-3 on CNTY-AFC-REC;
CPE_4 is IPS-SIC-25 on CNTY-AFC-REC;
CPE_5 is IPS-SIC-34 on CNTY-AFC-REC;
CPE_6 is PSE-SC-CAT-6 on CNTY-AFC-REC;
CPE_7 is IPS-SIC-26 on CNTY-AFC-REC;
CPE_8 is PSE-SC-CAT-8 on CNTY-AFC-REC;
CPE_9 is PSE-SC-CAT-9 on CNTY-AFC-REC;
CPE_{10} is IPS-SIC-36 on CNTY-AFC-REC;
CPE_{11} is PSE-SC-CAT-11 on CNTY-AFC-REC;
CPE_{12} is PSE-SC-CAT-12 on CNTY-AFC-REC;
CPE_{13} is PSE-DG-CAT-13 on CNTY-AFC-REC;
CPE_{14} is PSE-DC-CAT-14 on CNTY-AFC-REC;
CPE_{15} is PSE-PP-CAT-15 on CNTY-AFC-REC;
CPE_{16} is IPS-SIC-30 on CNTY-AFC-REC;
CPE_{17} is PSE-SC-CAT-11; and
CPE_{18} is 0)

NE_u = Number of individuals in nation in solvent-user category u

(NE_1 is SC-CRNT-POP on NTL-AFC-REC;
NE_2 is SC-SIC-7535 on NTL-AFC-REC;
NE_3 is SC-SIC-371 on NTL-AFC-REC;
NE_4 is SC-SIC-25 on NTL-AFC-REC;
NE_5 is SC-SIC-34 on NTL-AFC-REC;
NE_6 is SC-SIC-35-36 on NTL-AFC-REC;
NE_7 is SC-SIC-26 on NTL-AFC-REC;

NE_8 is SC-SIC-243-244 on NTL-AFC-REC;
NE_9 is SC-SIC-37 on NTL-AFC-REC;
NE_{10} is SC-SIC-36 on NTL-AFC-REC;
NE_{11} is SC-TOT-MFG-EMP on NTL-AFC-REC;
NE_{12} is SC-SIC-373 on NTL-AFC-REC;
NE_{13} is DG-SIC-34-39 on NTL-AFC-REC;
NE_{14} is DC-SOLV-LDRS on NTL-AFC-REC;
NE_{15} is PP-SIC-264-265-27 on NTL-AFC-REC;
NE_{16} is RP-SIC-30 on NTL-AFC-REC;
NE_{17} is SC-TOT-MFG-EMP;
NE_{18} is SC-CRNT-POP)

NPE_u = Number of individuals in nation in point source solvent-user category u

(NPE_1 is 0;
NPE_2 is PSE-SIC-7535 on NTL-AFC-REC;
NPE_3 is PSE-SIC-371 on NTL-AFC-REC;
NPE_4 is PSE-SIC-25 on NTL-AFC-REC;
NPE_5 is PSE-SIC-34 on NTL-AFC-REC;
NPE_6 is PSE-SIC-35-36 on NTL-AFC-REC;
NPE_7 is PSE-SIC-26 on NTL-AFC-REC;
NPE_8 is PSE-SIC-243-244 on NTL-AFC-REC;
NPE_9 is PSE-SIC 37 on NTL-AFC-REC;
NPE_{10} is PSE-SIC-36 on NTL-AFC-REC;
NPE_{11} is PSE-SIC-20-39 on NTL-AFC-REC;
NPE_{12} is PSE-SIC-373 on NTL-AFC-REC;
NPE_{13} is PSE-SIC-34-39 on NTL-AFC-REC;
NPE_{14} is PSE-SIC-7215 on NTL-AFC-REC;
NPE_{15} is PSE-SIC-264-265-27 on NTL-AFC-REC;
NPE_{16} is PSE-SIC-30 on NTL-AFC-REC;
NPE_{17} is PSE-SIC-20-39;
NPE_{18} is 0)

NOS_su = National consumption of solvent type s by solvent-user category u

(s=1 for Special Naphthas;
s=2 for Penchloroethylene;
s-3 for Ethanol;
s=4 for Trichloroethylene;
s=5 for Isopropanol;
s=6 for Acetone;
s=7 for Glycol Ethers;
s=8 for Cyclohexanone
s=9 for M.E.K.;

s=10 for Ethyl Benzene
s=11 for Propylene Glycol
s=12 for Methanol;
s=13 for Butyl Acetate;
s=14 for Ethyl Acetate;
s=15 for Butyl Alcohols;
s=16 for M.I.B.K.;
s=17 for all Other Solvents

NOS_{su} is computed using the formula:

$$NOS_{su} = (CST_s * 500) * PSU_{su}$$

Where:

CST_s = Published total national consumption of solvent type s (one of seventeen data items within NTL-ORG-SOLV-CONS filed of NTL-AFC-REC depending on value of s, 1-17)

PSU_{su} = Per cent of solvent type s that is consumed by solvent-user category u (per cent for 17 solvent types found on seventeen TAB-3-11 records in element USER-PRCNT of file NADB-CONTROL; per cent of solvent use for surface-coatings is broken down into 12 solvent-user categories by multiplying value in USER-PRCNT-S-CTNGS field by 12 per cent found on TAB-3-13 record in element USER-PRCNT; per cent of solvent use for other miscellaneous uses is distributed 25%, to solvent user category 17 and 75% to solvent user category 18.

VIII. Fuel Consumption by Residential Sources (4 estimates)

County fuel consumption by residential sources is calculated separately for four different fuel types:

1) County Residential Natural Gas Consumption (RNG) is computed using the formula:

$$RNG = NCG + (0.00922 * NCL)$$

where:

NCG = A normalized estimate of county residential natural gas consumption (computed with formulas given below)

NCL = A normalized estimate of county residential LPG consumption)computed with formulas given below)

(0.00922 is the factor used to convert killogallons of LPG to its natural gas equivalent in 10^7 cu. ft.)

(A) A normalized estimate of county residential natural gas consumption (NCG) is produced by execution of the following formulas:

$$NCG = \frac{ECG}{\sum_{c=1}^{n} ECG_c} * \left(\frac{SNG}{10}\right)$$

where:

ECG = Estimated county natural gas consumption by residential sources in therms (computed with formula given below)

n = Number of counties in state (STE-NO-CNTYS on STE-AFC-REC)

SNG = Published state residential natural gas consumption in 10^6 cu. ft. (N-G-RES on STE-AFC-REC)

ECG is computed using the formula:

$$ECG = 47.5 * UG * DD^{0.367} * \left[\frac{UGH}{UX}\right]^{0.588} * MR^{0.125}$$

where:

UG = Number of occupied dwelling units in county using gas in current year (computed with formula that follows)

DD = Annual heating degree days in county (CNTY-DEG-DAYS on CNTY-AFC-REC)

UGH = Number of occupied dwelling units in county using gas heat in census year (SH-GAS-HT on CNTY-AFC-REC)

UX = Number of occupied dwelling units in county using gas for cooking or hot water fuel in census year, whichever is larger (CKG-GAS or WH-GAS on CNTY-AFC-REC) (if UX = 0, it is set to 1 to prevent division by 0)

MR = Median number of rooms per dwelling unit in the county (CNTY-NO-RMS on CNTY-AFC-REC)

UG is computed using the formula:

$$UG = \frac{CGH}{RPH}$$

where:

CGH = Number of occupied dwelling units in county using gas heat in current year (computed with formula below)

RPH = Per cent of residential gas customers in state with gas heat (STE-PCT-GAS-CUST on STE-AFC-REC)

CGH is computed using the formula:

$$CGH = UGH + IGH$$

where:

UGH = Number of occupied dwelling units in county using gas heat in census year (SH-GAS-HT on CNTY-AFC-REC)

IGH = Total increase since census year in county dwelling units using gas for space-heating (computed with following formula)

$$IGH = \frac{CPC}{\sum_{c=1}^{n} CPC_c} * A + \left(\frac{UGH}{SGH} * C\right)$$

where:

CPC = Growth in county population since census year (computed with formula below)

A = Number of additional gas-heated dwelling units in state due to new housing starts since census year (sum of up to eleven data items within the STE-NEW-HSG-ADINS field of STE-AFC-REC, depending on how many years since last census)

UGH = Number of occupied dwelling units in county using gas heat in census year (SH-GAS-HT on CNTY-AFC-REC)

SGH = Number of occupied dwelling units in state using gas heat in census year (STE-GAS-HSG-UNTS on STE-AFC-REC)

C = Number of conversions to gas space heating in the state since census year (sum of up to eleven data items within the STE-GAS-H-CONV field of STE-AFC-REC, depending on how many years since last census)

CPC = CP-CCP (NOTE: IF $CP-CCP \leq 0$, then $CPC = 0$)

where:

CP = Current county population (SC-CAT-1 on CNTY-AFC-REC)

CCP = County population in most recent census year (CNTY-C-YR-POP on CNTY-AFC-REC)

(B) A normalized estimate of county residential LPG consumption (NCL) is computed by the following formulas:

$$\text{If } \sum_{c=1}^{n} ECL_c > (SRL-SPL), \text{ then } NCL = \frac{ECL}{\sum_{c=1}^{n} ECL_c} * (SRL-SPL)$$

$$\text{If } \sum_{c=1}^{n} ECL_c \leq (SRL-SPL), \text{ then } NCL = ECL$$

where:

ECL = Estimated county LPG consumption by residential sources in kilogallons (computed with formula given below)

n = Number of counties in state (STE-NO-CNTYS on STE-AFC-REC)

SRL = State retail LPG shipments (LPG-RET on STE-AFC-REC)

SPL = State commercial point source LPG comsumption (LPG-C-C on STE-AFC-REC)

ECL is computed using the formula:

$$ECL = 0.00105 * CLT$$

where:

CLT = Estimated county residential LPG consumption in therms (computed with formula given below)

(0.00105 is the factor used to convert therms to killogallons of LPG)

CLT is computed using the formula:

$$CLT = (376+0.209DD)*ULH+(RAW*ULW)+(RAC*ULC)$$

where:

DD = Annual heating degree days in county (CNTY-DEG-DAYS on CNTY-AFC-REC)

ULH = Number of occupied dwelling units in county using LPG for space heating in census year (SH-LPG-HT on CNTY-AFC-REC)

RAW = Average regional consumption (therms/yr.) of gas by water heaters (one of nine data items within NTL-AVG-GAS-W-H field of NTL-AFC-REC, depending on which census region county is in)

ULW = Number of occupied dwelling units in county using LPG for heating water in census year (WH-LPG on CNTY-AFC-REC)

RAC = Average regional consumption (therms/yr.) of gas by cooking ranges (one of nine data items within NTL-AVG-GAS-CONS field of NTL-AFC-REC, depending on which census region county is in)

ULC = Number of occupied dwelling units in county using LPG as cooking fuel in census year (CKG-LPG on CNTY-AFC-REC)

2) and 3) Normalized County Residential Bituminous (CRB) and Anthracite (CRA) Consumption are computed by the following formulas:

(A) If: $\sum_{c=1}^{n} ERB_c \leq 1000(SRB-SPB)$ and $\sum_{c=1}^{n} ERA_c \leq (STA-SPA)$, then

$$CRB = \frac{ERB}{10} \quad \text{and} \quad CRA = \frac{ERA}{10}$$

where:

ERB = Estimated county bituminous consumption by residential sources (computed with a formula given below in Section D)

n = Number of counties in state (STE-NO-CNTYS on STE-AFC-REC)

SRB = Retail shipments of bituminous coal to state (R-U-TOT on STE-AFC-REC)

SPB = State commercial point source bituminous consumption (BC-C-C on STE-AFC-REC)

ERA = Estimated county anthracite consumption by residential sources (computed with a formula given below in Section D)

STA = Total anthracite shipments to state (STE-ANTH-SHPMNTS on STE-AFC-REC)

SPA = State total point source anthracite consumption (STE-ANTH-CONS on STE-AFC-REC)

(B) If: $\sum_{c=1}^{n} ERB_c > 1000(SRB-SPB)$ and $\sum_{c=1}^{n} ERA_c > (STA-SPA)$, then

$$CRB = \frac{ERB}{10} * \left[\frac{(SRB-SPB)}{\sum_{c=1}^{n} ERB_c} \right] \quad \text{and} \quad CRA = \frac{ERA}{10} * \left[\frac{(STA-SPA)}{\sum_{c=1}^{n} ERA_c} \right]$$

where:

definition of variables in equations is same as that given above in Section A.

(C) If:

$$\left[\begin{array}{c}\sum_{c=1}^{n} ERB_c > 1000(SRB-SPB) \\ \text{AND} \\ \sum_{c=1}^{n} ERA_c \leq (STA-SPA)\end{array}\right] \text{ OR } \left[\begin{array}{c}\sum_{c=1}^{n} ERB_c \leq 1000(SRB-SPB) \\ \text{AND} \\ \sum_{c=1}^{n} ERA_c > (STA-SPA)\end{array}\right],$$

then, estimates of county residential consumption of bituminous (ERB) and anthracite (ERA) are normalized by distributing the excess computed consumption of one coal type among counties and adding it to the consumption figure computed for the other coal type as follows:

with: X_s = state retail area source consumption of one coal type (i.e., $[1000*(SRB-SPB)]$, or $[STA-SPA]$)

Y_s = state retail area source consumption of the other coal type

x = calculated county residential area source consumption corresponding to coal type of X_s (i.e., ERB or ERA)

y = calculated county residential area source consumption corresponding to coal type of Y_s

let: x_s = statewide sum of calculated residential consumption for all n counties in state for one coal type (i.e., $\sum_{c=1}^{n} ERB_c$, or $\sum_{c=1}^{n} ERA_c$), such that

$$x_s > X_s$$

y_s = statewide sum of calculated residential consumption for all n counties in state for the other coal type such that $y_s < Y_s$

The excess computed statewide consumption of coal type x (ex_s) is computed with the equation:

$$ex_s = x_s - X_s$$

and the difference between reported state retail consumption and computed statewide consumption of coal type y (ry_s) is computed with the equation:

$$ry_s = Y_s - y_s$$

A normalization factor (nf) is determined by a comparison of the excess amount of one coal type with the remainder amount of the other coal type:

If $ex_s \leq ry_s$, then $nf = ex_s$

If $ex_s > ry_s$, then $nf = ry_s$

This normalization factor is used to adjust the calculated estimates of county residential consumption with the following formulas:

$$y' = \frac{y^*}{10}\left(1+\frac{nf}{Y_s}\right)$$

$$x' = \frac{x^*}{10}\left(\frac{X_s}{x_s}\right)$$

where:

x' = Normalized county residential consumption of coal type x (i.e., CRB or CRA)

y' = Adjusted county residential consumption of coal type y (i.e., CRB or CRA)

Variables listed below have same definitions as given in Section A above:

ERB
ERA
SRB
SPB
STA
SPA
n

(D) The estimates of county residential consumption of bituminous coal (ERB) and anthracite coal (ERA), which are adjusted as explained in Sections A through C above, are computed with the following formulas:

$$ERA = PMA * C$$

$$ERB = (1-PMA) * C$$

where:

PMA = Per cent of state's residential coal market that is anthracite (STE-RES-MKT-SHR on STE-AFC-REC)

C = County residential coal consumption (both anthracite and bituminous; computed below).

$$C = 0.00387*UCH*e^{\left(7.64-\frac{1000.0}{DD}\right)}$$

where:

UCH = Number of occupied dwelling units in county using coal heat in current year (computed with formula given below)

DD = Annual heating degree days in county (CNTY-DEG-DAYS on CNTY-AFC-REC)

UCH is computed using the formula:

$$UCH = CCH + ICH$$

where:

CCH = Number of occupied dwelling units in county using coal heat in census year (SH-COAL-HT on CNTY-AFC-REC)

ICH = Increase in coal-heated dwelling units in county since census year (computed below)

ICH = CCH*CRG

where:

CCH = Number of coal-heated dwelling units in county, census year (SH-COAL-HT on CNTY-AFC-REC)

CRG = Regional growth in coal-heated housing (one of nine data items within the NTL-GRWTH-HSG field of NTL-AFC-REC, depending on which census region county is in)

4) County Residential Distillate Oil (10^4 gal./yr.) Consumption (RDO) is computed using the formula:

$$RDO = \frac{\left(\frac{.01288DD+30.41MR - 79.54}{.14}\right) * UOH+250UOW}{10,000}$$

where:

DD = Annual heating degree days in county (CNTY-DEG-DAYS on CNTY-AFC-REC)

MR = Median number of rooms per dwelling unit in the county (CNTY-NO-RMS on CNTY-AFC-REC)

UOH = Number of occupied dwelling units in county using oil heat in current year (computed with formula given below)

UOW = Number of occupied dwelling units in county using oil for heating water in census year (WH-OIL on CNTY-AFC-REC)

The formula used to compute UOH is:

UOH = COH + (PCO*COH)

where:

COH = Number of occupied dwelling units in county using oil heat in census year (SH-OIL-HT on CNTY-AFC-REC)

PCO = Percentage change in oil burners since census year (STE-PCT-CHG on STE-AFC-REC)

IX. Fuel Consumption by Industrial Sources (4 estimates)

County fuel consumption by industrial sources is calculated separately for four different fuel types:

1) A normalized estimate of County Industrial Residual Oil (10^4 gal./yr.) Consumption (NCR) is computed using the formula:

$$NCR = \left[\frac{CIF_1 * 42)}{10}\right] * \left[\frac{SIR}{\sum_{c=1}^{n} (CIF_{1,c} * 42)}\right]$$

where:

CIF_1 = Estimated county residual oil consumption by industrial sources (computed with formula given below in Section IX. 5.)

n = Number of counties in state (STE-NO-CNTYS on STE-AFC-REC)

SIR = Reported state industrial area source residual oil con-consumption (computed below)

SIR = TSR - SPR
IF SIR < 0, SIR = 0

where:

SPR = State industrial point source residual oil consumption (RO-I-C on STE-AFC-REC)

TSR = Total state industrial residual oil consumption (computed below)

$$TSR = \left[(EF*SRH) + SRI + SRO\right] * 42$$

where:

SRO = State residual oil sales to oil companies (OCU-RESID on STE-AFC-REC)

SRI - State residual oil sales to industry (RESID-O-S on STE-AFC-REC

SRH = State residual oil sales for heating purposes (STE-R-O-SLS on STE-AFC-REC)

EF = An industrial employment fraction determined as follows:

$$\frac{SME}{SME+SCE}$$

where:

SME = Total state manufacturing employment (STE-TOT-MFG-EMP on STE-AFC-REC)

SCE = Total state commercial employment (STE-TOT-COM-EMP on STE-AFC-REC)

2) A normalized estimate of County Industrial Distillate Oil (10^4 gal./yr/) Consumption (NCD) is computed using the formula:

$$NCD = \left[\frac{(CIF_2 * 42)}{10}\right] * \left[\frac{SID}{\sum_{c=1}^{n} (CIF_{2,c} * 42)}\right]$$

where:

CIF_2 = Estimated county distillate oil consumption by industrial sources)computed with formula given below in Section IX. 5.)

n = Number of counties in state

SID = Reported state industrial area source distillate oil consumption (computed below)

SID = TSD - SPD
IF SID < 0, SID = 0

where:

SPD = State industrial point source distillate oil consumption DO-I-C on STE-AFC-REC)

TSD = Total state industrial distillate oil consumption (computed below)

$$TSD = EF * \left[(42*SDH)-SDR\right] + \left[42*(SDI+SDO)\right]$$

where:

EF = An industrial employment fraction (determined as described in Section IX. 1. above)

SDH = State distillate oil sales for heating purposes (sum of following three fields on STE-AFC-REC: DO-NO-1, DO-NO-2 and DO-NO-4)

SDR = State residential distillate oil consumption $\left[\sum_{c=1}^{n} RDO_c\right] * 10$,

where RDO is county residential distillate oil consumption as computed in Section VIII. 4. above)

SDI = State distillate oil sales to industry (DIST-O-S on STE-AFC-REC)

SDO = State distillate oil sales to oil companies (OCU-DIST on STE-AFC-REC)

3) A normalized estimate of County Industrial Natural Gas (10^7 ft^3/yr.) Consumption (NCG) is computed using the formula:

$$NCG = (10 * CIF_3) * \left(\frac{SIG}{\sum_{c=1}^{n} CIF_{3,c}}\right)$$

where:

CIF_3 = Estimated county natural gas consumption by industrial sources computed with formula given below in Section IX. 5.)

n = Number of counties in state

SIG = Reported state industrial area source natural gas consumption (computed below)

$$SIG = \frac{(TSG-SPG)}{100} + cf(TSL-SPL)$$

IF TSG-SPG < 0, then TSG-SPG = 0
IF TSL-SPL < 0, then TSL-SPL = 0
in above calculation

where:

TSG = Total state industrial natural gas consumption (N-G-IND on STE-AFC-REC)

SPG = State industrial point source natural gas consumption (NG-I-C on STE-AFC-REC)

cf = 0.000922, the factor used to convert killogallons of LPG to its natural gas equivalent in 10^8 cu. ft.

TSL = Total state sales of LPG to industry (LPG-IND on STE-AFC-REC)

SPL - State industrial point source LPG consumption (LPG-I-C on STE-AFC-REC)

4) A normalized estimate of County Industrial Bituminous Coal (10^1 tons/yr.) Consumption (NCB) is computed using the formula:

$$NCB = (10 * CIF_4) * \left(\frac{SIB}{\sum_{c=1}^{n} CIF_{4,c}} \right)$$

where:

CIF_4 = Estimated county bituminous consumption by industrial sources (computed with formula given below in Section IX. 5.)

n = Number of counties in state

SIB = Reported state industrial area source bituminous consumption (computed below)

SIB = 10 * (TSB-SPB)
IF SIB < 0, SIB = 0

where:

TSB = Published total of bituminous shipments to state for industrial consumption (I-U-TOT on STE-AFC-REC)

SPB = State industrial point source bituminous consumption (BC-I-C on STE-AFC-REC)

5) Estimates of County Industrial fuel consumption (CIF_1 through CIF_4) are derived with the following formula:

$$CIF_i = \sum_{j=1}^{20} CAE_j * FIR_{ij}$$

where:

CIF_i = Estimated county industrial area source consumption of fuel type i (i=1 for residual oil; i=2 for distillate oil; i=3 for natural gas; i=4 for bituminous coal)

CAE_j = County area source employment for SIC_j where j=1-20 for SIC codes 20-39 (CAE_j is determined with an equation given below)

FIR_{ij} = Fuel intensity ratio, a measure of fuel use intensity per employee, for fuel type i by SIC category j (computed with another formula given below)

CAE_j is determined as follows:

$$CAE_j = TCE_j - CPE_j$$

where:

TCE_j = Total employment in county for SIC category j (one of first twenty data items within CNTY-EMPLOYMENT field of CNTY-AFC-REC depending on value of j)

CPE_j = Point Source employment in county for SIC category j (one of twenty data items within CNTY-I-P-S-EMP field of CNTY-AFC-REC depending on value of j)

FIR_{ij} is computed with the following formula:

$$FIR_{ij} = \frac{F_{ij}}{E_j}$$

where:

F_{ij} = State consumption of fuel type i by SIC category j (one of twenty data items within the STE-IND-R-O-CONS field of STE-AFC-REC for F_{1j} depending on the value of j; one of twenty data items within the STE-IND-D-O-CONS field for F_2 j depending on the value of j; one of twenty data items within the STE-IND-N-G-CONS field for F_{3j}, one of twenty data items within the STE-IND-C-CONS field for F_{4j})

E_j = Total employment in state for SIC category j in year of most recent Census of Manufacturers (one of twenty data items within the STE-CBP-EMP-TOTS field of STE-AFC-REC depending on value of j)

NOTE: If input data is not available to compute state fuel intensity ratios, then NFR_{ij} is substituted for FIR_{ij} in the formula used to compute estimates of county industrial fuel consumption (CIF_1 through CIF_4). In this case the formula used is:

$$CIF_i = \sum_{j=1}^{20} CAE_j * NFR_{ij}$$

Where NFR_{ij} is a national fuel intensity ratio for fuel type i by SIC category j, computed with the formula:

$$NFR_{ij} = \frac{NF_{ij}}{NE_j}$$

where:

NF_{ij} = National consumption of fuel type i by SIC category j (one of twenty data items within the NTL-IND-R-OIL-CONS field of NTL-AFC-REC for NF_{1j} depending on the value of j; one of twenty data items within the NTL-D-OIL-CONS field for NF_{2j}) depending on the value of j; one of twenty data items within the NTL-IND-NAT-GS-CONS field for NF_3j: one of twenty data items within the NTL-IND-CL-CONS field for NF_4j)

NE_j = Total employment in nation for SIC category j in year of most recent Census of Manufacturers (one of twenty data items within the NTL-CBP-EMP-TOTS field of NTL-AFC-REC depending on value of j)

X. Fuel Consumption by Commercial and Institutional Sources (5 estimates)

County fuel consumption by commercial sources is calculated separately for five different fuel types:

1) A normalized estimate of Total County Commercial Natural Gas consumption (CTG) is computed using the formula:

$$CTG = CNG + (0.00922*CLG)$$

where:

CNG = A normalized estimate of county commercial natural gas consumption (computed with formula below)

CLG = A normalized estimate of county commercial LPG consumption (computed with formula below)

0.0092 is the factor used to convert killogallons of LPG to its natural gas equivalent in 10^7 cu. ft.

(A) A normalized estimate of County Commercial Natural Gas Consumption (CNG) is produced by execution of the following formulas:

$$CNG = (n_1 * f_1 * T_1) + FO_1$$

where:

n_1 = A normalization factor for consumption of natural gas by the five "special" commercial categories: hotels, hospitals, laundries, schools, and universities (determined as described below)

f_1 = 9.69×10^{-6}; the factor used to convert fuel consumption from therms to its natural gas equivalent in 10^7 cu. ft.

T_1 = Estimated county natural gas consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

FO_1 = County natural gas consumption by all other commercial categories (computed below)

$$FO_1 = SFO_1 * \left(\frac{COE}{SOE}\right)$$

where:

SFO_1 = State natural gas consumption by "other" commercial categories (determined as described below)

COE= County employment for "other" commercial categories (CBP-SIC-OTHR on CNTY-AFC-REC)

SOE = State employment for "other" commercial categories (OTHR-COML-EMP on STE-AFC-REC)

The variables SFO_1 and n_1, used in equations above, are determined as follows:

If $X_1 > F_1$, then $SFO_1 = X_1 - F_1$ and $n_1 = 1$

If $X_1 \leq F_1$, then $SFO_1 = 0$ and $n_1 = \frac{X_1}{F_1}$ (IF X1 < 0, N, = 0)

where:

X_1 = Published state total commercial area source consumption of natural gas (computed by formula given below)

F_1 = Estimated state total natural gas consumption by the five "special" categories (computed by formula given below)

The formula used to compute X_1 is:

$$X_1 = \frac{(G_1 + G_2) - G_p}{10}$$

where:

G_1 = Statewide consumption of natural gas for commercial use (N-G-COML on STE-AFC-REC)

G_2 = Other gas sales in state (N-G-OTHR on STE-AFC-REC)

G_p = State point source natural gas consumption by commercial sources (NG-C-C on STE-AFC-REC)

The formula used to compute F_1 is:

$$F_1 = f_1 * \left(\sum_{c=1}^{n} T_{1,c} \right)$$

where:

f_1 = Factor to convert fuel consumption from therms to its natural gas equivalent in 10^7 cu. ft. (9.69×10^{-6})

n = Number of counties in state (STE-NO-CNTYS on STE-AFC-REC)

T_1 = Estimated county natural gas consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

(B) A normalized estimate of County Commercial LPG Consumption (CLG) is produced by execution of the following formulas:

$$CLG = (n_2 * f_2 * T_2) + FO_2$$

where:

n_2 = A normalization factor for consumption of LPG by the five "special" commercial categories (determined as described below)

f_2 = 1.05×10^{-3}; the factor used to convert fuel consumption from therms to its LPG equivalent in 10^3 gal.

T_2 = Estimated county LPG consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

FO_2 = County LPG consumption by all other commercial categories (computed below)

$$FO_2 = SFO_2 * \left(\frac{COE}{SOE}\right)$$

where:

SFO_2 = State LPG consumption by "other" commercial categories (determined as described below)

COE = County employment for "other" commercial categories (CBP-SIC-OTHR on CNTY-AFC-REC)

SOE = State employment for "other" commercial categories (OTHR-COML-EMP on STE-AFC-REC)

The variables SFO_2 and n_2, used in equations above, are determined as follows:

If $X_2 > F_2$, then $SFO_2 = X_2 - F_2$, and $n_2 = 1$

If $X_2 \leq F_2$, then $SFO_2 = 0$, and $n_2 = \frac{X_2}{F_2}$ (IF $X_2 < 0$, $N_2 = 0$)

where:

X_2 = State total commercial area source consumption of LPG (computed by formula given below)

F_2 = Estimated state total LPG consumption by the five "special" categories (computed by formula given below)

The formula used to compute X_2 is:

$$X_2 = L - \left(L_p + \sum_{c=1}^{n} ECL_c \right)$$

where:

L = Statewide retail sales of LPG (LPG-RET on STE-AFC-REC)

L_p = State point source LPG consumption by commercial sources (LPG-C-C on STE-AFC-REC)

n = Number of counties in state

ECL = Estimated county LPG consumption by residential sources (as computed by formula given in Section VIII. 1. B. above)

The formula used to compute F_2 is:

$$F_2 = f_2 * \left(\sum_{c=1}^{n} T_{2,c} \right)$$

where:

f_2 = Factor to convert fuel consumption from therms to its LPG equivalent in 10^3 gal. (1.05×10^{-3})

n = Number of counties in state

T_2 = Estimated county LPG consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

2) A normalized estimate of County Commercial Anthracite Consumption (CTA) is computed using the formula:

$$CTA = (n_3 * f_3 * T_3) + FO_3$$

where:

n_3 = A normalization factor for consumption of anthracite coal by the five "special" commercial categories (determined as described below)

f_3 = 4.07×10^{-4}; the factor used to convert fuel consumption from therms to its anthracite equivalent in 10^1 tons

T_3 = Estimated county anthracite consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

FO_3 = County anthracite consumption by all other commercial categories (computed below)

$$FO_3 = SFO_3 * \left(\frac{COE}{SOE} \right)$$

where:

SFO_3 = State anthracite consumption by "other" commercial categories (determined as described below)

COE = County employment for "other" commercial categories

SOE = State employment for "other" commercial categories

The variables SFO_3 and n_3, used in equations above are determined as follows:

If $X_3 > F_3$, then $SFO_3 = X_3 - F_3$, and $n_3 = 1$

If $X_3 \leq F_3$, then $SFO_3 = 0$, and $n_3 = \frac{X_3}{F_3}$ (IF $X_3 < 0$, $N_3 = 0$)

where:

X_3 = State total commercial area source consumption of anthracite (computed by formula given below)

F_3 = Estimated state-total anthracite consumption by the five "special" categories (computed by formula given below)

The formula used to compute X_3 is:

$$X_3 = \left(\frac{A - A_p}{10} \right) - \left(\sum_{c=1}^{n} CRA_c \right)$$

where:

A = Shipments of anthracite coal to the state (STE-ANTH-SHPMNTS on STE-AFC-REC)

A_p = State point source anthracite consumption by all sources (STE-ANTH-CONS on STE-AFC-REC)

n = Number of counties in state

CRA = Normalized county anthracite consumption by residential sources (as computed by the formula given in Section VIII. 3. above)

The formula used to compute F_3 is:

$$F_3 = f_3 * \left(\sum_{c=1}^{n} T_{3,c} \right)$$

where:

f_3 = Factor to convert fuel consumption from therms to its anthracite equivalent in 10^{1} tons (4.07×10^{-4})

n = Number of counties in state

T_3 = Estimated county anthracite consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

3) A normalized estimate of County Commercial Bituminous Coal Consumption (CTB) is computed using the formula:

$$CTB = (n_4 * f_4 * T_4) + FO_4$$

where:

n_4 = A normalization factor for consumption of bituminous coal by the five "special" commercial categories (determined as described below)

f_4 = 3.85×10^{-4}; the factor used to convert fuel consumption from therms to its bituminous equivalent in 10^{1} tons

T_4 - Estimated county bituminous consumption by the five "special" commercial categories in therms (computed by formula given in Section X. 6. below)

FO_4 = County bituminous consumption by all other commercial categories (computed below)

$$FO_4 = SFO_4 * \left(\frac{COE}{SOE} \right)$$

where:

SFO_4 = State bituminous consumption by "other" commercial categories (determined as described below)

COE = County employment for "other" commercial categories

SOE = State employment for "other" commercial categories

The variables SFO_4 and n_4 used in equations above, are determined as follows:

If $X_4 > F_4$, then $SFO_4 = X_4 - F_4$, and $n_4 = 1$

If $X_4 \leq F_4$, then $SFO_4 = 0$, and $n_4 = \frac{X_4}{F_4}$ (IF $X_4 < 0$, $N_4 = 0$)

where:

X_4 = State total commercial area source consumption of bituminous (computed by formula given below)

F_4 = Estimated state total bituminous consumption by the five "special" categories (computed by formula given below)

The formula used to compute X_4 is:

$$X_4 = \left[100 * (B - B_p) \right] - \left(\sum_{c=1}^{n} CRB_c \right)$$

where:

B = Shipments of bituminous coal to retail dealers in the state (R-U-TOT on STE-AFC-REC)

B_p = State point source bituminous consumption by commercial sources (BC-C-C on STE-AFC-REC)

n = Number of counties in state

CRB = Normalized county bituminous consumption by residential sources (as computed by the formula given in Section VIII. 2. above)

The formula used to compute F_4 is:

$$F_4 = f_4 * \left(\sum_{c=1}^{n} T_{4,c} \right)$$

where:

f_4 = Factor to convert fuel consumption from therms to its bituminous equivalent in 10^1 tons (3.85×10^{-4})

n = Number of counties in state

T_4 = Estimated county bituminous consumption by the five "special" commercial categories in therms (computed by the formula given in Section X. 6. below)

4) A normalized estimate of County Commercial Residual Oil Consumption (CTR) is computed using the formula:

$$CTR = (n_5 * f_5 * T_5) + FO_5$$

where:

n_5 = A normalization factor for consumption of residual oil by the five "special" commercial categories (determined as described below)

f_5 = 6.67×10^{-5}; the factor used to convert fuel consumption from therms to its residual oil equivalent in 10^4 gal.

T_5 = Estimated county residual oil consumption by the five "special" commercial categories in therms (computed by the formula given in Section X. 6. below)

FO_5 = County residual oil consumption by all other commercial categories (computed below)

$$FO_5 = SFO_5 * \left(\frac{COE}{SOE} \right)$$

where:

SFO_5 = State residual oil consumption by "other" commercial categories (determined as described below)

COE = County employment for "other" commercial categories

SOE = State employment for "other" commercial categories

The variables SFO_5 and n_5, used in equations above, are determined as follows:

If $X_5 > F_5$, then $SFO_5 = X_5 - F_5$, and $n_5 = 1$

If $X_5 \leq F_5$, then $SFO_5 = 0$, and $n_5 = \frac{X_5}{F_5}$ (IF $X_5 < 0$, $N_5 = 0$)

where:

X_5 = State total commercial area source consumption of residual oil (computed by formula given below)

F_5 = Estimated state total residual oil consumption by the five "special" categories (computed by formula given below)

The formula used to compute X_5 is:

$$X_5 = \frac{\left[42 * (CEF*SRH)\right] + (42*SRM) - R_p}{10}$$

where:

R_p = State point source residual oil consumption by commercial sources (RO-C-C on STE-AFC-REC)

SRM = State residual oil sales to the military (MLT-RESID on STE-AFC-REC)

SRH = State residual oil sales for heating purposes (STE-R-O-SLS on STE-AFC-REC)

CEF is a commercial employment fraction determined as follows:

$$CEF = \frac{SCE}{SME+SCE}$$

where:

SCE = Total state commercial employment (STE-TOT-COM-EMP on STE-AFC-REC)

SME = Total state manufacturing employment (STE-TOT-MFG-EMP on STE-AFC-REC)

The formula used to compute F_5 is:

$$F_5 = f_5 * \left(\sum_{c=1}^{n} T_{5,c} \right)$$

where:

f_5 = Factor to convert fuel consumption from therms to its residual oil equivalent in 10^4 gal. (6.67×10^{-5})

n = Number of counties in state

T_5 = Estimated county residual oil consumption by the five "special" commercial categories in therms (computed by the formula given in Section X. 6. below)

5) A normalized estimate of County Commercial Distillate Oil consumption (CTD) is computed using the formula:

$$CTD = (n_6 * f_6 * T_6) + FO_6$$

where:

n_6 = A normalization factor for consumption of distillate oil by the five "special" commercial categories (determined as described below)

f_6 = 7.14×10^{-5}; the factor used to convert fuel consumption from therms to its distillate oil equivalent in 10^4 gal.

T_6 = Estimated county distillate oil consumption by the five "special" commercial categories in therms (computed by the formula given in Section X. 6. below)

FO_6 = County distillate oil consumption by all other commercial categories (computed below)

$$FO_6 = SFO_6 * \left(\frac{COE}{SOE} \right)$$

where:

SFO_6 = State distillate oil consumption by "other" commercial categories (determined as described below)

COE = County employment for "other" commercial categories

SOE = State employment for "other" commercial categories

The variables SFO_6 and n_6, used in equations above, are determined as follows:

If $X_6 > F_6$, then $SFO_6 = X_6 - F_6$, and $n_6 = 1$

If $X_6 \leq F_6$, then $SFO_6 = 0$ and $n_6 = \frac{X_6}{F_6}$ (IF $X_6 < 0$, $N_6 = 0$)

where:

X_6 = State total commercial area source consumption of distillate oil (computed by formula given below)

F_6 = Estimated state total distillate oil consumption by the five "special" categories (computed by formula given below)

The formula used to compute X_6 is:

$$X_6 = CEF \left[(SDH*4.2) - \left(\sum_{c=1}^{n} RDO_c \right) \right] + (SDM*4.2) - \frac{D_p}{10}$$

where:

D_p = State point source distillate oil consumption by commercial sources (DO-C-C on STE-AFC-REC)

RDO = Estimated county distillate oil consumption by residential sources (as computed by the formula given in Section VIII. 4. above)

n = Number of counties in state

SDM = State distillate oil sales to the military (MLT-DIST on STE-AFC-REC)

SDH = State distillate oil sales for heating purposes (sum of following three data items on STE-AFC-REC: DO-NO-1, DO-NO-2, and DO-NO-4)

CEF is a commercial employment fraction determined as follows:

$$CEF = \frac{SCE}{SME+SCE}$$

where:

SCE = Total state commercial employment

SME = Total state manufacturing employment

The formula used to compute F_6 is:

$$F_6 = f_6 * \left(\sum_{c=1}^{n} T_{6,c} \right)$$

where:

f_6 = Factor to convert fuel consumption from therms to its distillate oil equivalent in 10^4 gal. (7.14×10^{-5})

n = Number of counties in state

T_6 = Estimated county distillate oil consumption by the five "special" commercial categories in therms (computed by the formula given below)

6) The variables T_1 through T_6 (used in the formulas given in Sections X. 1. through X. 5. above) are calculated by distributing total county fuel consumption by the five "special" commercial categories among six different fuel types. This distribution is made according to the residential fuel use pattern of each county. Formulas for accomplishing this distribution are as follows:

(A) $T_1 = TSC * \frac{UGH}{TUH}$

where:

T_1 = Estimated county natural gas consumption by the "special" commercial categories

TSC = Total county fuel consumption by "special" commercial categories (computed with formula given in Section X. 7. below)

UGH = Number of gas-heated dwelling units in county in most recent census year (SH-GAS-HT on CNTY-AFC-REC)

TUH = Total number of dwelling units in county heated by fuel types whose statewide commercial area source consumption (computed as X_1 through X_6 in sections 1-5 above) are greater than zero.

The formula for computing TUH is:

$$TUH = UG + UL + UC + UO$$

where UG, UL, UC, and UO are determined as follows:

UG: If $X_1 > 0$, then UG = UGH

If $X_1 \leq 0$, then UG = 0

where:

X_1 = State total commercial area source consumption of natural gas (as computed in Section X. 1. A. above)

UGH = Number of gas-heated dwelling units in county in census year

UL: If $X_2 > 0$, then UL = ULH

If $X_2 \leq 0$, then UL = 0

where:

X_2 = State total commercial area source consumption of LPG (as computed in Section X. 1. B. above)

ULH = Number of LPG-heated dwelling units in county in census year

UC: If $(X_3 + X_4) > 0$, then UC = UCH

If $(X_3 + X_4) \leq 0$, then UC = 0

where:

X_3 = State total commercial area source consumption of anthracite (as computed in Section X. 2. above)

X_4 = State total commercial area source consumption of bituminous (as computed in Section X. 3. above)

UCH = Number of coal-heated dwelling units in county in census year

UO: If $(X_5 + X_6) > 0$, then UO = UOH

If $(X_5 + X_6) \leq 0$, then UO = 0

where:

X_5 = State total commercial area source consumption of residual oil (as computed in Section X. 4. above)

X_6 = State total commercial area source consumption of distillate oil (as computed in Section X. 5. above)

UOH = Number of oil-heated dwelling units in county in census year

NOTE: If X_1 is not greater than zero, then T_1 is not computed but is assumed to equal zero.

(B) $$T_2 = TSC * \frac{ULH}{TUH}$$

where:

T_2 = Estimated county LPG consumption by the "special" commercial categories

TSC = Total county fuel consumption by "special" commercial categories (computed with formula given in Section X. 7. below)

ULH = Number of LPG-heated dwelling units in county in most recent census year (SH-LPG-HT on CNTY-AFC-REC)

TUH is computed as described in Section X. 6. A. above

NOTE: If X_2 is not greater than zero, then T_2 is not computed but is assumed to equal zero.

(C) $$T_3 = TCC * \left(\frac{X_3}{X_3+X_4} \right)$$

where:

T_3 = Estimated county anthracite consumption by the "special" commercial categories

X_3 and X_4 are state totals as described in Section X. 6. A. above

TCC = Estimated county total coal consumption by "special" commercial categories, computed as follows:

$$TCC = TSC * \frac{UCH}{TUH}$$

where:

TSC = Total county fuel consumption by "special" commercial categories (computed with formula given in Section X. 7. below)

UCH = Number of coal-heated dwelling units in county in most recent census year (SH-COAL-HT on CNTY-AFC-REC)

TUH is computed as described in Section X. 6. A. above

NOTE: If the sum of X_3 and X_4 is not greater than zero, then TCC is not computed but is assumed to equal zero.

(D) $$T_4 = TCC * \left(\frac{X_4}{X_3+X_4} \right)$$

where:

T_4 = Estimated county bituminous consumption by the "special" commercial categories

X_3 and X_4 are state totals as described in Section X. 6. A. above

TCC = Estimated county total coal consumption by "special" commercial categories (computed in Section X. 6. C. above)

(E) $$T_5 = TOC * \left(\frac{X_5}{X_5+X_6} \right)$$

where:

T_5 = Estimated county residual oil consumption by the "special" commercial categories

X_5 and X_6 are state totals as described in Section X. 6. A. above

TOC = Estimated county total oil consumption by "special" commercial categories, computed as follows:

$$TOC = TSC * \frac{UOH}{TUH}$$

where:

TSC = Total county fuel consumption by "special" commercial categories (computed with formula given in Section X. 7. below)

UOH = Number of oil-heated dwelling units in county in most recent census year (SH-OIL-HT on CNTY-AFC-REC)

TUH is computed as described in Section X. 6. A. above

NOTE: If the sum of X_5 and X_6 is not greater than zero, then TOC is not computed but is assumed to equal zero.

(F) $$T_6 = TOC * \left(\frac{X_6}{X_5+X_6} \right)$$

where:

T_6 = Estimated county distillate oil consumption by the "special" commercial categories

X_5 and X_6 are state totals as described in Section X. 6. A. above

TOC = Estimated county total oil consumption by "special" commercial categories (computed in Section X. 6. E. above)

7) Total county fuel consumption in therms by the five "special" commercial categories (TSC) is computed as follows:

TSC = CHP + CH + CS + CU + CL

where:

CHP = Total fuel in therms consumed in county by hospitals (computed with formula given below)

CH = Total fuel in therms consumed in county by hotels (computed with formula given below)

CS = Total fuel in therms consumed in county by schools (computed with formula given below)

CU = Total fuel in therms consumed in county by universities (computed with formula given below)

CL = Total fuel in therms consumed in county by laundries (computed with formula given below)

(A) Hospitals:

$$CHP = (126.5*BD)+(12.7*DD)+(77.4*HPE)-(5.72\times10^4)$$

where:

BD = Number of hospital beds in county (CNTY-NO-HOSP-BDS on CNTY-AFC-REC)

DD = Annual heating degree days in county (CNTY-DEG-DAYS on CNTY-AFC-REC)

HPE = Total hospital employment in county (CNTY-NO-HOSP-EMP on CNTY-AFC-REC)

(B) Hotels:

$$CH = 8.05 * 10^{-17} * R_f^{1.84} * DD^{3.99} * \left[R_f + 2.84(R - R_f)\right]$$

where:

DD = Annual heating degree days in county

R = Number of hotel rooms in county (computed below)

R_f is determined as follows:

If $R > 100$, then $R_f = 100$

If $R \leq 100$, then $R_f = R$

The formula for computing R is:

$$R = \frac{CHE}{SR}$$

where:

CHE = County hotel employment (CBP-SIC-7010 on CNTY-AFC-REC)

SR = Hotel employees per room ratio for the state (STE-HTL-EMP on STE-AFC-REC)

(C) Schools:

$$CS = (165 * SE) + (4.10 * DD) - (1.81 \times 10^4)$$

where:

DD = Annual heating degree days in county

SE = County school employment computed as follows:

$$SE = \frac{SES}{SSE} * CSE$$

where:

CSE = County school enrollment (CNTY-SCH-ENRL on CNTY-AFC-REC)

SSE = State school enrollment (STE-SCH-ENRL on STE-AFC-REC)

SES = State school employment (sum of two fields on STE-AFC-REC: PRV-SCH and STE-NO-P-S-EMP)

(D) Universities:

$$CU = (229*UE)+(51.5*DD)-(2.94*10^{5})$$

where:

DD = Annual heating degree days in county

UE = County university employment computed as follows:

UE = CUE * NER

where:

CUE = County university enrollment in both public and private institutions (CNTY-UNIV-ENRL on CNTY-AFC-REC)

NER = National ratio of university employees to enrollees (NTL-UNIV-RATIO on NTL-AFC-REC)

(E) Laundries:

$$CL = (531*LE)-(1.28*10^{4})$$

where:

LE = County employment in laundries (CBP-SIC-LNDRS on CNTY-AFC-REC)

XI. Sulfur and Ash Content of Coal (4 estimates)

Two different methods are used for estimating sulfur and ash content of bituminous coal and anthracite coal used by area sources in each county.

Because there is only one anthracite-producing region in the country, one value each for sulfur content and ash content is used for all counties:

1) Sulfur Content of Anthracite Coal for each county (AS) is not computed by program NE099; a national value input to the program is used without any alterations:

AS = NIV

where:

NIV = National input value for sulfur content of anthracite (NTL-PCT-SULF on NTL-AFC-REC)

2) Ash Content of Anthracite Coal for each county (AA) is not computed; an input national value is used:

AA = NAV

where:

NAV = National input value for ash content of anthracite (NTL-PCT-ASH on NTL-AFC-REC)

Sulfur and ash contents of bituminous coal used by county area sources are computed as follows:

3) Sulfur Content of Bituminous Coal for each county (BS) is computed using the formula:

$$BS = \frac{[SSR*(CRB+CTB)] + (SSI*NCB)}{CRB+CTB+NCB}$$ (See note below.)

where:

SSR = Sulfur content (%) of bituminous coal shipped to the state for retail area source users (computed with a formula given below)

SSI = Sulfur content (%) of bituminous coal shipped to the state for industrial area source users (computed with a formula in Section XI. 3. B. below)

CRB = Normalized county consumption of bituminous by residential area sources (as computed by formula given above in Section VIII. 2.)

CTB = Normalized county consumption of bituminous by commercial area sources (as computed by formula given above in Section X. 3.)

NCB = Normalized county consumption of bituminous by industrial area sources (as computed by formula given above in Section IX. 4.)

NOTE: If the result produced by this calculation exceeds 7%, set BS = 7%.

Average sulfur contents of bituminous shipped to the state for retail users (SSR) and for industrial users (SSI) are computed with the following formulas:

(A) Retail Users

$$SSR = \frac{\left(\sum_{d=1}^{20} NS_d * SRB_d\right) - BPS}{\left(\sum_{d=1}^{20} SRB_d\right) - BPC}$$

NOTE: If $BPC > \sum_{d=1}^{20} SRB_d$, OR

If $BPS > \sum_{d=1}^{20} NS_d * SRB_d$,

substitute the following equation for the one given to the left:

$$SSR = \frac{\sum_{d=1}^{20} NS_d * SRB_d}{\sum_{d=1}^{20} SRB_d}$$

where:

NS_d = Average sulfur content (%) of bituminous shipped from production district/district grouping d for use by retail and industrial sources (computed with formula given below)

SRB_d = Bituminous shipments to state from production district/district grouping d for retail use (one of last twenty data items within STE-R-U-SHPMNTS field of STE-AFC-REC depending on value of d)

BPS = Weight of sulfur in bituminous coal consumed in state by commercial point sources (SULF-C-C on STE-AFC-REC)

BPC = Bituminous coal consumed in the state by commercial point sources (BC-C-C on STE-AFC-REC)

d = 1 for production district #1;
2 for production district #2
3 for grouping of district #3 and #6
4 for production district #4
5 for production district #7
6 for production district #8
7 for production district #9
8 for production district #10
9 for production district #11
10 for production district #12
11 for production district #13
12 for production district #14

13 for production district #15
14 for production district #16
15 for production district #17
16 for production district #18
17 for production district #19
18 for production district #20
19 for production district #21
20 for grouping of districts #22 and #23

The formula used to compute NS_d is:

$$NS_d = \frac{(IBS_d * ISC_d) + (OBS_d * OSC_d)}{IBS_d + OBS_d}$$

where:

d = 1-20 excluding 3 and 20

IBS_d = Shipments of bituminous coal from production district d to "Other Industrial and Retail Users" (one of eighteen selected data items within the NTL-I-R-U-BIT-SHP field of NTL-AFC-REC depending on value of d)

ISC_d = Sulfur content of bituminous from production district d shipped to "Other Industrial and Retail Users (one of eighteen selected data items within the NTL-I-R-AVG-SUL field of NTL-AFC-REC depending on value of d)

OBS_d = Shipments of bituminous coal from production district d to "All Other Users" (one of eighteen selected data items within the NTL-A-O-U-BIT-SHP field of NTL-AFC-REC depending on value of d)

OSC_d = Sulfur Content of bituminous from production district d shipped to "All Other Users" (one of eighteen selected data items within the NTL-AVG-SUL-A-O-U field of NTL-AFC-REC depending on value of d)

For combined district groupings (d=3 or d=20) comprised of districts j and k, the formula is:

$$NS_d = \frac{(IBS_j * ISC_j) + (IBS_k * ISC_k) + (OBS_j * OSC_j) + (OBS_k * OSC_k)}{IBS_j + IBS_k + OBS_j + OBS_k}$$

where:

IBS_j = Shipments of bituminous coal from production district j to "Other Industrial and Retail Users" (if d=3, IBS_j is I-R-U-DIST3 on NTL-AFC-REC; if d=20, IBS_j is I-R-U-DIST22 on NTL-AFC-REC)

IBS_k = Shipments of bituminous coal from production district k to "Other Industrial and Retail Users" (if d=3, IBS_k is I-R-U-DIST6 on NTL-AFC-REC; if d=20, IBS_k is I-R-U-DIST23 on NTL-AFC-REC)

ISC_j = Sulfur content of bituminous from production district j shipped to "Other Industrial and Retail Users" (if d=3, ISC_j is I-R-DIST3 on NTL-AFC-REC; if d=20, ISC_j is I-R-DIST22 on NTL-AFC-REC)

ISC_k = Sulfur content of bituminous from production district k shipped to "Other Industrial and Retail Users" (if d=3, ISC_k is I-R-DIST6 on NTL-AFC-REC; if d=20, ISC_k is I-R-DIST23 on NTL-AFC-REC)

OBS_j = Shipments of bituminous coal from production district j to "All Other Users" (if d=3, OBS_j is BIT-SHP-DIST3 on NTL-AFC-REC; if d=20, OBS_j is BIT-SHP-DIST22 on NTL-AFC-REC)

OBS_k = Shipments of bituminous coal from production district k to "All Other Users" (if d=3, OBS_k is BIT-SHP-DIST6 on NTL-AFC-REC; if d=20, OBS_k is BIT-SHP-DIST23 on NTL-AFC-REC)

OSC_j = Sulfur content of bituminous from production district j shipped to "All Other Users" (if d=3, OSC_j is A-O-U-DIST3 on NTL-AFC-REC, if d=20, OSC_j is A-O-U-DIST22 on NTL-AFC-REC)

OSC_k = Sulfur content of bituminous from production district k shipped to "All Other Users" (if d=3, OSC_k is A-O-U-DIST6 on NTL-AFC-REC; if d=20, OSC_k is A-O-U-DIST23 on NTL-AFC-REC

(B) Industrial Users

$$SSI = \frac{\left(\sum_{d=1}^{20} NS_d * SIB_d\right) - IPS}{\left(\sum_{d=1}^{20} SIB_d\right) - IPB}$$

NOTE: If $IPB > \sum_{d=1}^{20} SIB_d$, OR

If $IPS > \sum_{d=1}^{20} NS_d * SIB_d$,

substitute the following equation for the one given to the left:

$$SSI = \frac{\sum_{d=1}^{20} NS_d * SIB_d}{\sum^{20} SIB_d}$$

where:

NS_d = Average sulfur content (%) of bituminous shipped from production district/district grouping d for use by retail and industrial sources (as computed in Section XI. 3. A. above)

SIB_d = Bituminous shipments to state from production district/district grouping d for industrial use (one of last twenty data items within STE-I-U-SHPMNTS field of STE-AFC-REC depending on value of d)

IPS = Weight of sulfur in bituminous coal consumed in state by industrial point sources (SULF-I-C on STE-AFC-REC)

IPB = Bituminous coal consumed in the state by industrial point sources (BC-I-C on STE-AFC-REC)

The equivalencies for the values of d (1-20) are given in Section XI. 3. A. above

(4) Ash Content of Bituminous Coal for each county (BA) is computed using the formula:

$$BA = \frac{[ASR*(CRB+CTB)] + (ASI*NCB)}{CRB + CTB + NCB} \quad \text{(See note below.)}$$

where:

ASR = Ash content (%) of bituminous coal shipped to the state for retail area source users (computed with a formula given below)

ASI = Ash content (%) of bituminous coal shipped to the state for industrial area source users (computed with a formula given in Section XI. 4. B. below)

CRB = Normalized county consumption of bituminous by residential area sources (as computed by formula given in Section VIII. 2.)

CTB = Normalized county consumption of bituminous by commercial area sources (as computed by formulas given in Section X. 3.)

NOTE: If the result produced by this calculation exceeds 25%, set BA = 25%.

NCB = Normalized county consumption of bituminous by industrial area sources (as computed by formula given in Section IX. 4.)

Average ash contents of bituminous shipped to the state for retail users (ASR) and for industrial users (ASI) are computed with the following formulas:

(A) Retail Users

$$ASR = \frac{\left(\sum_{d=1}^{20} NA_d * SRB_d\right) - BPA}{\left(\sum_{d=1}^{20} SRB_d\right) - BPC}$$

NOTE: If $BPC > \sum_{d=1}^{20} SRB_d$, OR

If $BPA > \sum_{d=1}^{20} NA_d * SRB_d$,

substitute the following equation for the one given to the left:

$$ASR = \frac{\sum_{d=1}^{20} NA_d * SRB_d}{\sum_{d=1}^{20} SRB_d}$$

where:

NA_d = Average ash content (%) of bituminous shipped from production district/district grouping d to all users (one of eighteen selected data items within the NTL-AVG-ASH-CONT field of NTL-AFC-REC depending on value of d when d=1-20, excluding 3 and 20; when d=3 or d=20, NA_d is computed using the formula given below)

SRB_d = Bituminous shipments to state from production district/district grouping d for retail use (one of last twenty data items within STE-R-U-SHPMNTS field of STE-AFC-REC depending on value of d)

BPA = Weight of ash in bituminous coal consumed in state by commercial point sources (ASH-C-C on STE-AFC-REC)

BPC = Bituminous coal consumed in the state by commercial point sources (BC-C-C on STE-AFC-REC)

The equivalencies for the values of d (1-20) are given in Section XI 3. A. above

For combined district groupings (d=3 or d=20) comprised of districts j and k, the formula used to compute NA_d is:

$$NA_d = \frac{\left[(IBS_j+OBS_j)*AC_j\right] + \left[(IBS_k+OBS_k)*AC_k\right]}{IBS_j+OBS_j+IBS_k+OBS_k}$$

where:

IBS_j = Shipments of bituminous coal from production district j to "Other Industrial and Retail Users" (if d=3, IBS_j is I-R-U-DIST3 on NTL-AFC-REC, if d=20, IBS_j is I-R-U-DIST22 on NTL-AFC-REC)

IBS_k = Shipments of bituminous coal from production district k to "Other Industrial and Retail Users" (if d=3, IBS_k is I-R-U-DIST6 on NTL-AFC-REC, if d=20, IBS_k is I-R-U-DIST23 on NTL-AFC-REC)

OBS_j = Shipments of bituminous coal from production district j to "All Other Users" (if d=3, OBS_j is BIT-SHP-DIST3 on NTL-AFC-REC; if d=20, OBS_j is BIT-SHP-DIST22 on NTL-AFC-REC)

OBS_k = Shipments of bituminous coal from production district k to "All Other Users" (if d=3, OBS_k is BIT-SHP-DIST6 on NTL-AFC-REC; if d=20, OBS_k is BIT-SHP-DIST23 on NTL-AFC-REC)

AC_j = Ash content of coal shipped from production district j (if d=3, AC_j is A-A-C-DIST3 on NTL-AFC-REC; if d=20, AC_j is A-A-C-DIST22 on NTL-AFC-REC)

AC_k = Ash content of coal shipped from production district k (if d=3, AC_k is A-A-C-DIST6 on NTL-AFC-REC; if d=20, AC_k is A-A-C-DIST23 on NTL-AFC-REC)

(B) Industrial Users

$$ASI = \frac{\left(\sum_{d=1}^{20} NA_d*SIB_d\right) - IPA}{\left(\sum_{d=1}^{20} SIB_d\right) - IPB}$$

NOTE: If $IPB > \sum_{d=1}^{20} SIB_d$, OR

If $IPA > \sum_{d=1}^{20} NA_d * SIB_d$,

substitute the following equation for the one given to the left:

$$ASI = \frac{\sum_{d=1}^{20} NA_d * SIB_d}{\sum_{d=1}^{20} SIB_d}$$

where:

NA_d = Average ash content (%) of bituminous shipped from production district/district grouping d to all users (one of eighteen selected data items within the NTL-AVG-ASH-CONT field of NTL-AFC-REC depending on value of d when d=1-20, excluding 3 and 20; when d=3 or d=20, NA_d is the percentage computed by the formula given in Section XI. 4. A. above)

SIB_d = Bituminous shipments to state from production district/district grouping d for industrial use (one of last twenty data items within STE-I-U-SHPMNTS field of STE-AFC-REC depending on value of d)

IPA = Weight of ash in bituminous coal consumed in state by industrial point sources (ASH-I-C on STE-AFC-REC)

IPB = Bituminous coal consumed in the state by industrial point source (BC-I-C on STE-AFC-REC)

The equivalencies for the values of d (1-20) are given in Section XI. 3. A. above

XII. Sulfur Content of Oil (2 estimates)

Determination of the sulfur contents of fuel oil requires a systematic procedure that is complex and involves discretionary judgement. (See Section 2. 1. 3 of AEROS, Volume IV). Sulfur content of oil, therefore, is not computed by program NE099. Values determined by NADB are input to the program and used without any alteration.

1) Sulfur Content of Residual Oil (RS) is an input county value:

RS = CRS

where:

CRS = County input value for sulfur content of residual oil (CNTY-PCT-SULF-RO on CNTY-AFC-REC)

2) Sulfur Content of Distillate Oil (DS) is an input county value:

DS = CDS

where:

CDS = County input value for sulfur content of distillate oil (CNTY-PCT-SULF-DO on CNTY-AFC-REC)

ABSTRACT

DESCRIPTIVE NAME: Statewide Correction Factor Application

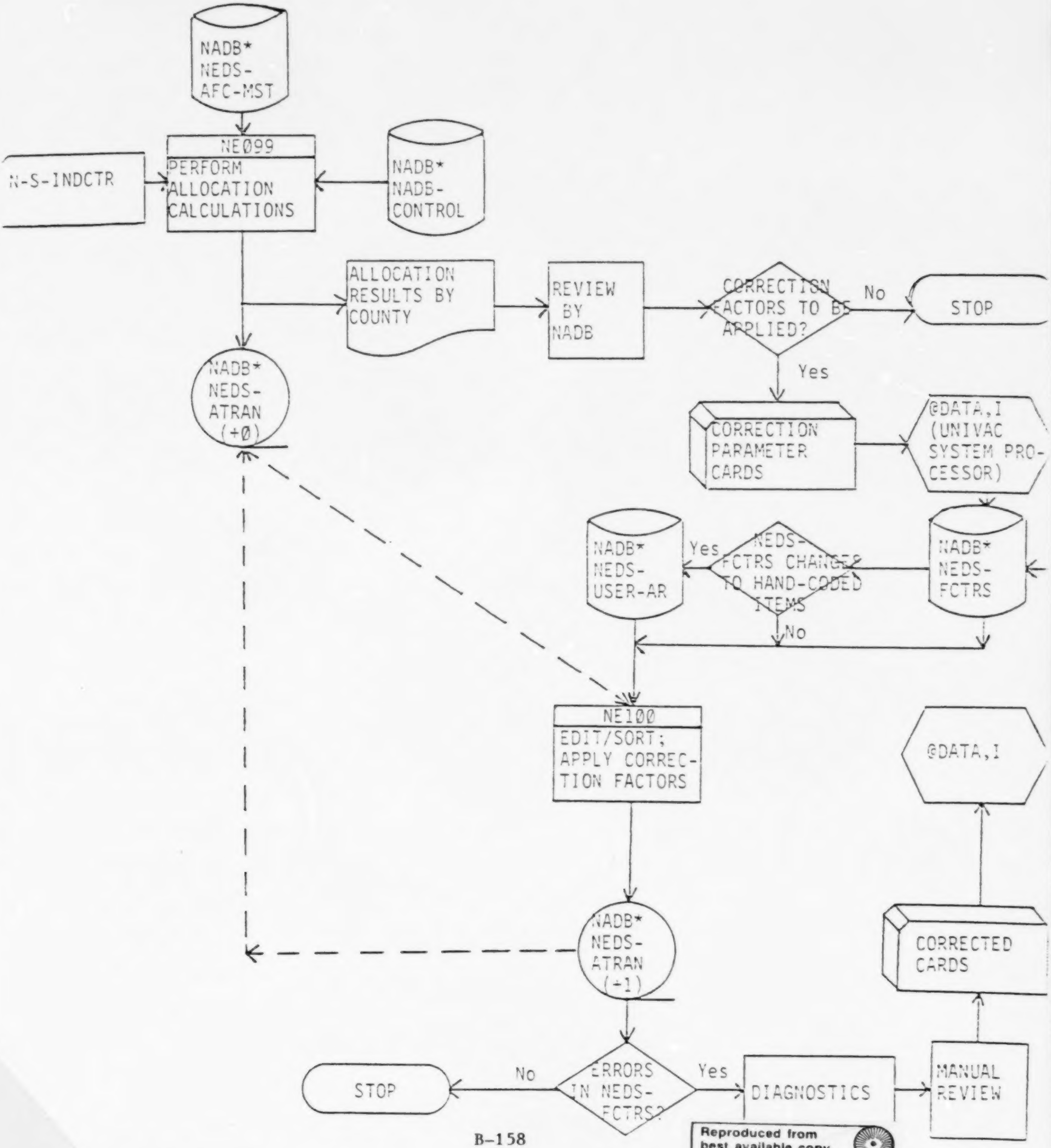
RUN DESCRIPTION

NE100 applies correction factors to estimates computed by program NE099 or to hand-coded data items on NEDS Area Source Form Cards 1 through 5. The program is executed at NADB's discretion during both annual and special statewide AFCA system runs.

NE100 has up to three sources of input. A card-image disk file containing NADB-requested corrections (NEDS-FCTRS) and the tape file created by program NE099 (NEDS-ATRAN) are input to every execution of the program. If corrections to hand-coded data items are required, the NEDS Area Source data base, NEDS-USER-AR, is input to NE100. File NEDS-FCTRS records contain: the SAROAD codes for states whose data is to be adjusted; card numbers and numeric codes indicating which data items are to be adjusted; and the adjustment factors to be applied to these data items.

NE100 sorts NEDS-FCTRS records by state and card number and computes adjusted estimates by matching specified correction factors to data items on file NEDS-ATRAN or file NEDS-USER-AR. Program output is an updated version of file NEDS-ATRAN which contains four or five card-image records per SAROAD county (five for states which have correction factors specified for data items on NEDS Area Source Card 5.)

SYSTEM CHARTS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NEDS-
AFC-MST
NE099
PERFORM
ALLOCATION
CALCULATIONS
N-S-INDCTR
NADB*
NADB-
CONTROL
ALLOCATION
RESULTS BY
COUNTY
REVIEW
BY
NADB
CORRECTION
FACTORS TO BE
APPLIED?
No
STOP
Yes
NADB*
NEDS-
ATRAN
(+0)
CORRECTION
PARAMETER
CARDS
@DATA,I
(UNIVAC
SYSTEM PRO-
CESSOR)
NADB*
NEDS-
USER-AR
Yes
NEDS-
FCTRS CHANGES
TO HAND-CODED
ITEMS
No
NADB*
NEDS-
FCTRS
NE100
EDIT/SORT;
APPLY CORREC-
TION FACTORS
@DATA,I
NADB*
NEDS-
ATRAN
(+1)
CORRECTED
CARDS
STOP
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ERRORS
IN NEDS-
FCTRS?
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DIAGNOSTICS
MANUAL
REVIEW

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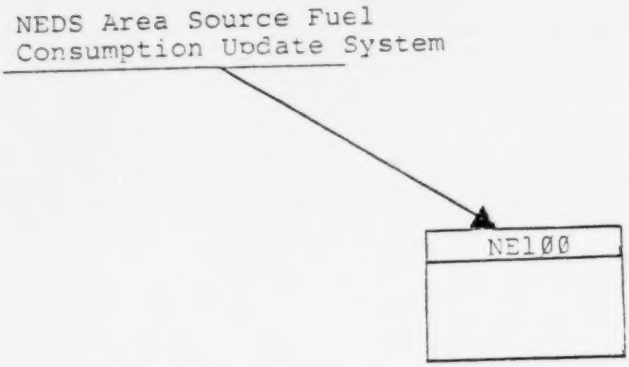
HIERARCHY CHART


NEDS Area Source Fuel Consumption Update System
NE100

AEROS SOFTWARE	COMPONENT NAME: NE108	SECTION 1 PAGE 1
DOCUMENTATION	SECTION: AEROS Abstract	DATE May, 1979

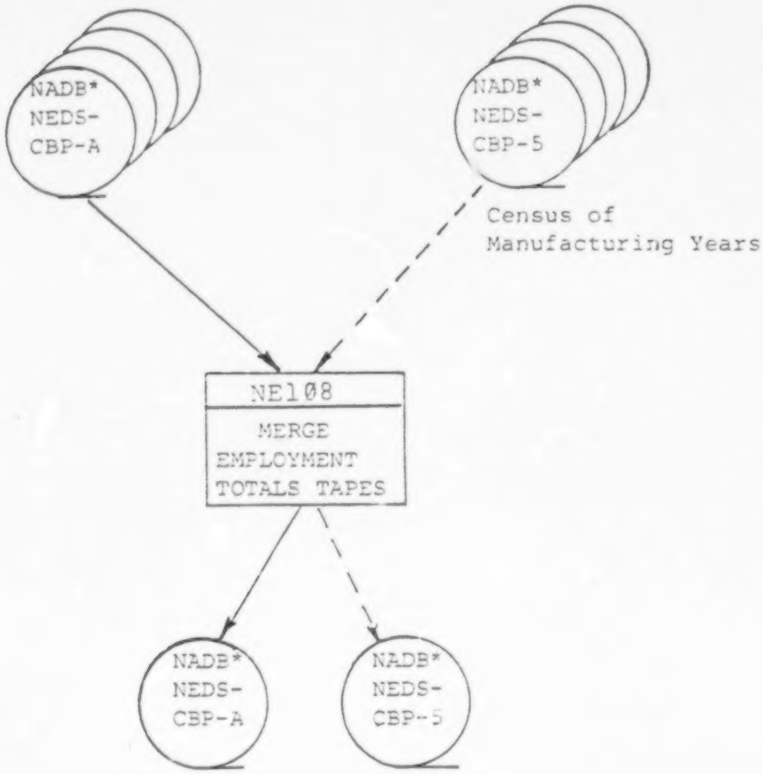
Descriptive Name: Merge Employment Totals Tapes

Run Description:

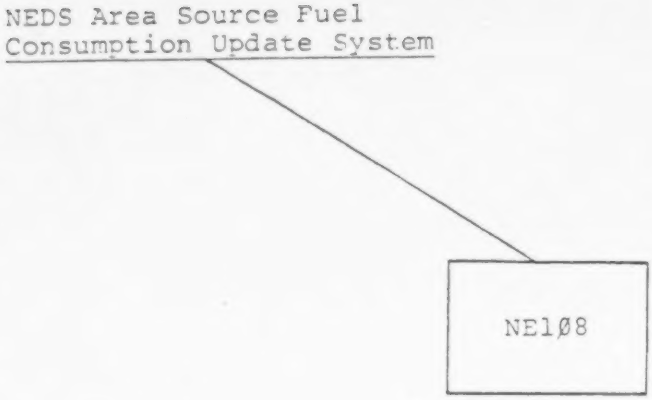
When NE086 runs have been successfully completed for all 9 census regions, the nine NEDS-CBP-A output tapes must be merged to one tape.

During Census of Manufacturing years each run of NE086 will also create a NEDS-CBP-5 tape. These must also be merged to one tape.

Output from the merge will be used as input to program NE087.


NADB*
NEDS-
CBP-A
NADB*
NEDS-
CBP-5
Census of
Manufacturing Years
NE108
MERGE
EMPLOYMENT
TOTALS TAPES
NADB*
NEDS-
CBP-A
NADB*
NEDS-
CBP-5

HIERARCHY CHARTS


NEDS Area Source Fuel Consumption Update System
NE108

NE111 ABSTRACT

Component Name

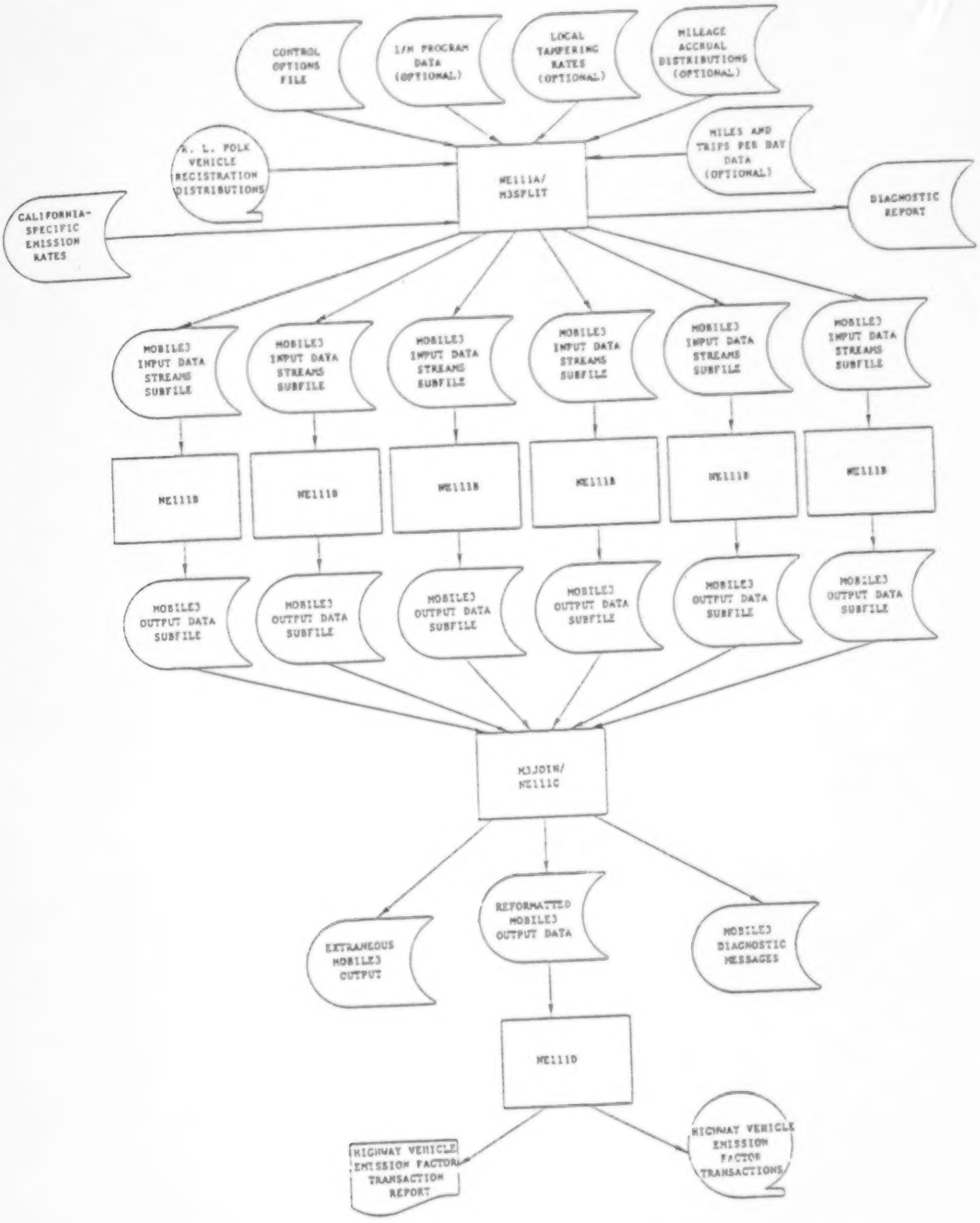
NE111: NEDS Highway Vehicle Emission Factor Calculation Program.

Run Description

NE111 calculates county-specific highway vehicle emission factors to be used in developing the NEDS area source emissions inventory. The methodologies used to calculate these emission factors are those of MOBILE3, the latest Mobile Source Emissions Model developed by the Office of Mobile Sources (OMS).

NE111 consists of four distinct and separately executed modules, which are executed on the NCC UNIVAC. The first constructs county-specific MOBILE3 input data sets, drawing data from several input files in the process. The second runs each data set through the MOBILE3 model, calculating emission factors for each county. The third summarizes the MOBILE3 emission factor output. The fourth module reformats the MOBILE3 output to form NEDS emission factor update transactions.

Output of NE111 consists of a tape file and a printer report. The tape file contains the generated emission factor update transactions, and is fed into the next NEDS program. The printer report echoes the update transactions in a more readable format, and presents diagnostics (if any) and summary statistics.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I/M PROGRAM DATA (OPTIONAL)
LOCAL TAMPERING RATES (OPTIONAL)
MILEAGE ACCRUAL DISTRIBUTIONS (OPTIONAL)
R. L. POLK VEHICLE REGISTRATION DISTRIBUTIONS
MILES AND TRIPS PER DAY DATA (OPTIONAL)
NE111A/ M3SPLIT
CALIFORNIA-SPECIFIC EMISSION RATES
DIAGNOSTIC REPORT
MOBILE3 INPUT DATA STREAMS SUBFILE
MOBILE3 INPUT DATA STREAMS SUBFILE
MOBILE3 INPUT DATA STREAMS SUBFILE
MOBILE3 INPUT DATA STREAMS SUBFILE
MOBILE3 INPUT DATA STREAMS SUBFILE
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M3JOIN/ NE111C
EXTRANEOUS MOBILE3 OUTPUT
REFORMATTED MOBILE3 OUTPUT DATA
MOBILE3 DIAGNOSTIC MESSAGES
NE111D
HIGHWAY VEHICLE EMISSION FACTOR TRANSACTION REPORT
HIGHWAY VEHICLE EMISSION FACTOR TRANSACTIONS

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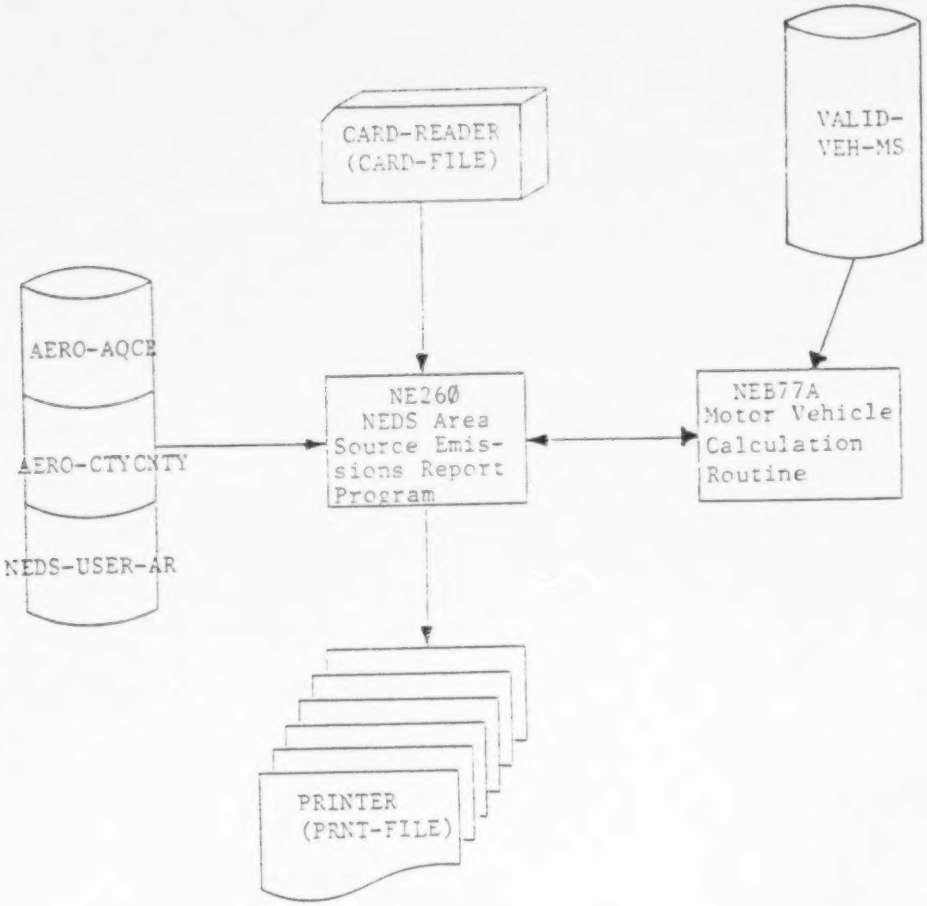
1. Component Name: NE260, NEDS AREA SOURCE EMISSIONS REPORT PROGRAM

2. Run Description:

Program NE260 produces the NEDS Area Source Emissions Report from data in the NEDS area source "user file", NADB*NEDS-USER-AR. For each defined category of area source emissions (64 standard, 20 optional), the report gives the calculated emissions in tons per year of five criteria pollutants (particulates, sulfur oxides, nitrogen oxides, volatile organic compounds, carbon monoxide) and the corresponding activity levels from which the emissions were calculated. The report consists of six pages, each page presenting the data for a group of related emission categories: total calculated emissions, SIP estimated emissions, and comments on page 1; fuel consumption data for stationary sources on page 2; solid waste disposal data on page 3; detailed motor vehicle data on page 4; transportation data (aircraft, vessels, vehicle summary) on page 5; and all other "miscellaneous" data on page 6. Each page includes totals and subtotals of emissions and activity levels where appropriate.

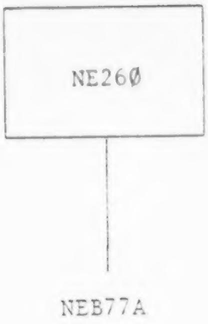
One or more select/control cards, coded by the program user, specify the geographic area for which data are selected from the area source user file, and the content of the printed report. Any geographic area may be selected which is properly described by state, county, and/or AQCR codes, as well as the entire United States. The report may include the data for each selected data record or only the totals of all selected records and each of the six pages of the report may be included or excluded.



VALID-
VEH-MS
CARD-READER
(CARD-FILE)
AERO-AQCR
AERO-CTYCNTY
NEDS-USER-AR
NE260
NEDS Area
Source Emis-
sions Report
Program
NEB77A
Motor Vehicle
Calculation
Routine
PRINTER
(PRNT-FILE)

System Chart: NE260

Note: 1. Internal filenames are shown in parenthesis except where they are the same as external name.



Hierarchy Chart: NE260